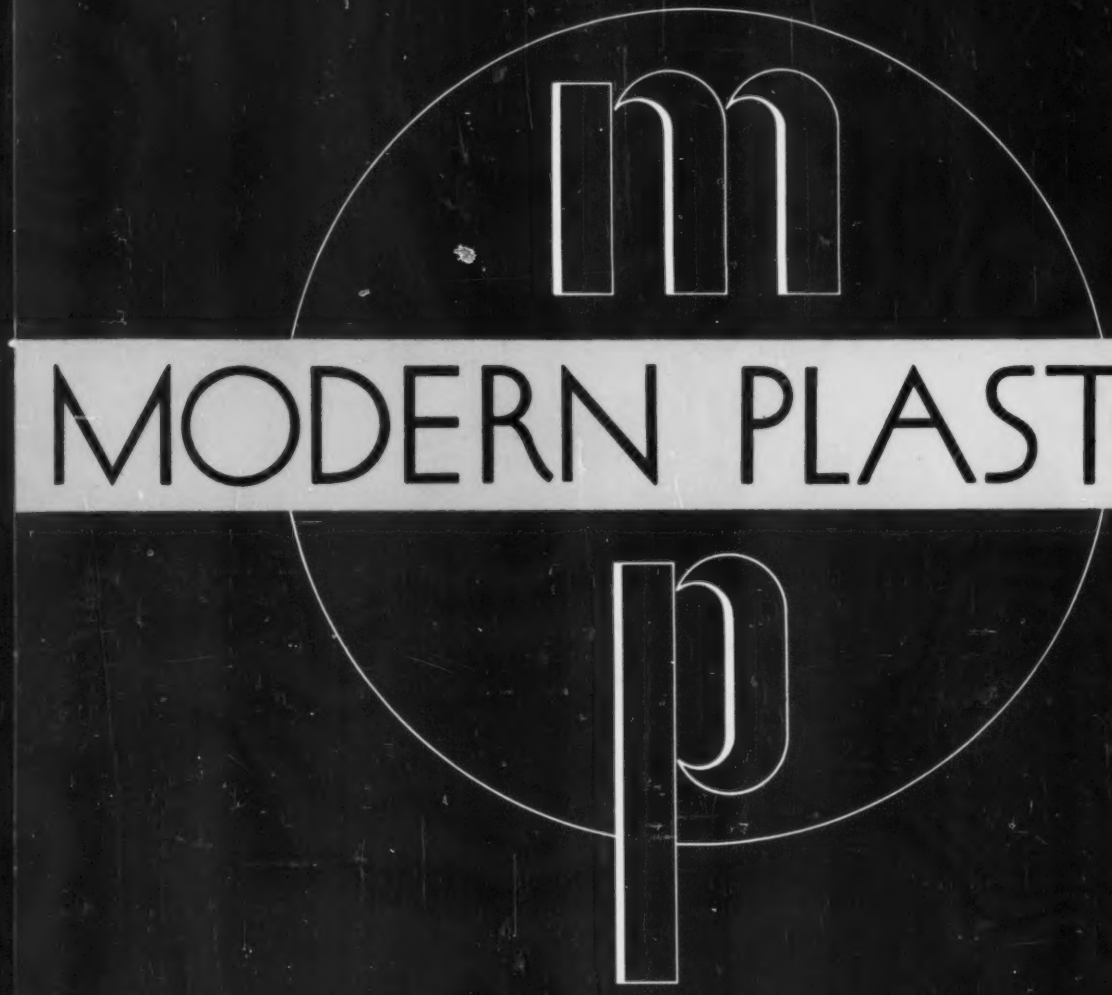

MODERN PLASTICS

SEPTEMBER 1954

YOUR BEST BET

for the greatest variety of jobs

"THE STANDARD OF THE INDUSTRY"

in General-Purpose Phenolics

● Molders know better than anybody else why Durez 791 Molding Compound is still the "ideal" general-purpose material: *It satisfies the requirements of the most jobs.* There are two reasons why this is so. First, 791 offers the well-balanced properties that mean success in diversified applications whether compression, transfer, or plunger molded. Second, its uniformity from batch to batch means that length of flow, speed of cure, dimensional stability, and properties of molded pieces do not vary. Let Durez 791 help you satisfy the most customers. For information and cooperation, contact Durez Plastics & Chemicals, Inc., 1209 Walck Road, North Tonawanda, N. Y.

DUREZ

PHENOLIC RESINS

- MOLDING COMPOUNDS
- INDUSTRIAL RESINS
- PROTECTIVE COATING RESINS

Phenolic Plastics for the New Era of Competition

CATALIN *Styrene*... molds *a place for manythings!*

A "working" demonstration of on-view orderliness and at-hand convenience . . . achieved, simply, by bracketing and tiering a cleverly designed crystal-clear bin!

In repeat arrangements, this one, strong CATALIN STYRENE-molded piece *multiplies* itself into a popular line of 6, 12, 18 and 24-drawer cabinets. (The 12-drawer model is pictured.) Molded-in channels and furnished separators further partition each bin into compartments. Pretty neat!

Aptly named "Swing Bins,"* this facility mounts to wall or bench-top, permits free radial movement of any one or all bins and tidily keeps its manythings in place. Bins can be swung out and alternately positioned to provide tall-item storage. Ideal for hobby room or workshop, this space-maker is equally welcome in the pantry, kitchen or bath.

We regard "Swing Bins" and its use of CATALIN STYRENE —*the gem of plastics*—as a prudent product . . . one that *swings* a powerful sales punch!

**Manufactured by Akro-Mils, Inc., Akron 9, Ohio*

CATALIN CORPORATION OF AMERICA
ONE PARK AVENUE • NEW YORK 16, N. Y.

CATALIN

In addition to Styrene Molding Compounds, Catalin chemical products include a wide range of Urea, Phenolic, Cresylic, Resorcinol, Melamine and Styrene Resin formulations

MODERN PLASTICS*

September 1954 • Vol. 32 No. 1

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Modern Plastics, published monthly by Breskin Publications, Inc., at Emmett St., Bristol, Conn. Modern Plastics Encyclopedia Issue published as second issue in September by Plastics Catalogue Corp., at Emmett St., Bristol, Conn. Executive and Editorial Office: 575 Madison Ave., New York 22, N. Y. Entered as second class matter at the Post Office at Bristol, Conn., December 14, 1950, under the Act of March 3, 1879.

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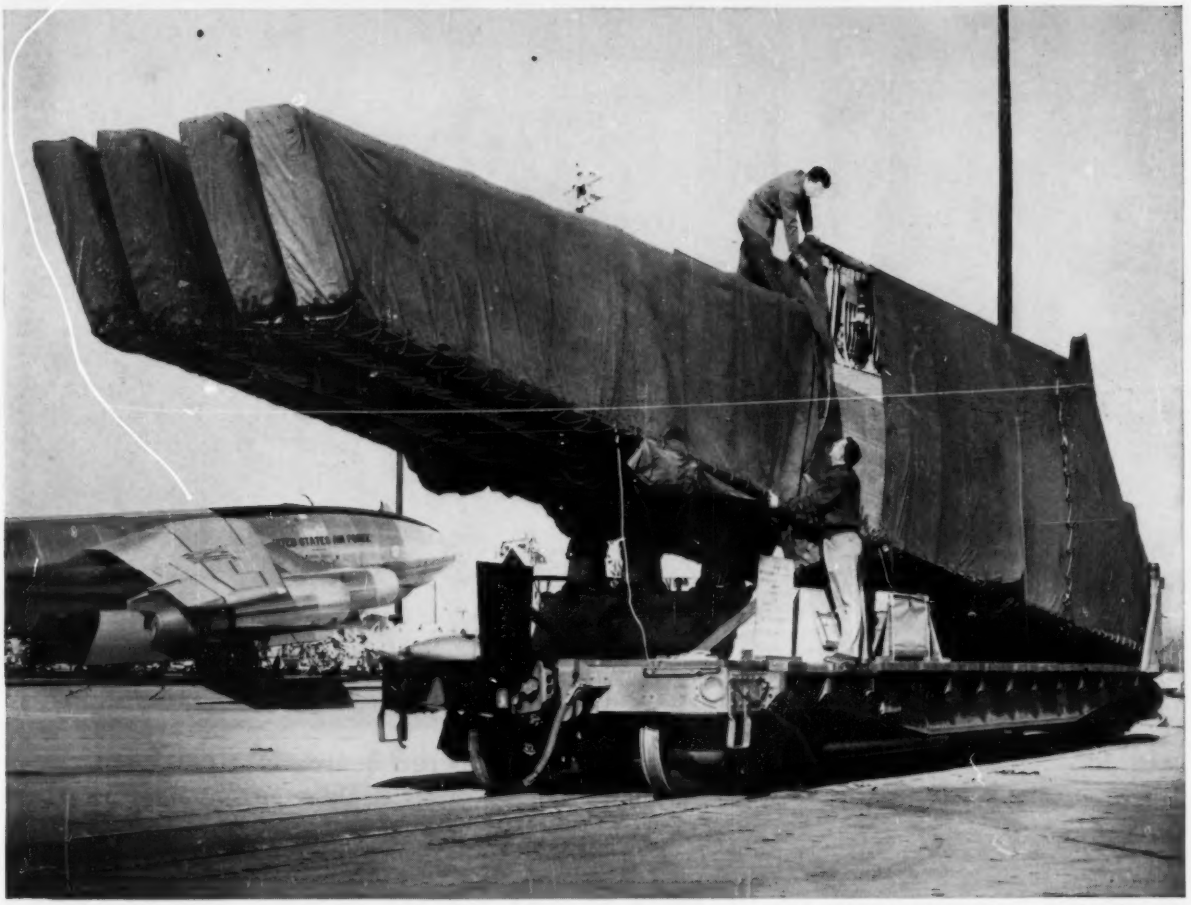
Another new development using

B. F. Goodrich Chemical *raw materials*



B. F. Goodrich Chemical Company does not make these wing covers. We supply only the Geon paste resin.

Cover-up story on Jet Wings

THESE wings for B-47 Stratojet bombers must be protected during rail shipment from sub-assembly plants to the Boeing Airplane Company's Wichita, Kansas, Division. Here's how Geon polyvinyl materials play a part in getting the wings there safely.

The wings are an oversize load, measuring 58 feet. They are shipped 2 pairs to a flat car and must be protected against damage from weather, smoke, soot and abrasion. A plastisol based on Geon paste resin coated over nylon fabric was used by the manufacturer for the special covers designed for this job. As the result, special crating or boxcars are not needed and wings are protected during open air storage, saving hangar and warehouse space.

Thanks to the Geon coating, these covers resist the effects of grease, oil, mildew and retard flame. High tensile and tear strength of the fabric and Geon coating have enabled the covers to make more than 70 trips—with more to come!

This use for a Geon material may give you ideas for solving a problem—or developing a product with ready sales appeal. Geon materials have many profitable uses, from upholstery and wire insulation to rigid tubing, sponge and more applications. For helpful technical information, please write Dept. GB-9, B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

GEON RESINS • GOOD-RITE PLASTICIZERS . . . the ideal team to make products easier, better and more saleable
GEON polyvinyl materials • HYCAR American rubber • GOOD-RITE chemicals and plasticizers • HARMON colors

large urea housings...flawlessly made...delivered in ample quantities...

—these are the reasons—

WHY TOLEDO SCALE PICKED CHICAGO MOLDED

It took Chicago Molded Products Corporation, with its long experience and giant presses, to solve the molding problems encountered in these big parts. Toledo Scale Company found we have a full understanding of the special techniques required to mold this urea plastic properly; plus the ability to design molds that work. To this was added a whole battery of presses big enough to handle these, and even larger jobs. The result – consistently perfect parts, delivered in ample quantities to meet Toledo's heavy schedules – a wholly successful molding job.

The gleaming Plaskon urea material provided the unique combination of advantages found in the housing of the Guardian 70 Duplex – Toledo Scale Company's leading model for direct service use in food stores. Its brilliant white surfaces look sanitary and *are* sanitary; the good looks are permanent, since the color goes all the way through. Its light weight makes the scale easy to demonstrate, easy to sell. Plaskon's combination of dimensional stability and inertness to foods and mineral oils, makes the Guardian 70 Duplex housing as durable as it is good looking.

If you would like to explore the possibilities of colorful thermosetting urea – or any other molded plastic for your product, Chicago Molded engineers will welcome the opportunity to go over your needs with you in detail – without the slightest obligation on your part. They can serve you best if called in before your designs are final.

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PRODUCTS CORPORATION
1046 North Kolmar Avenue
Chicago 51, Illinois
CUSTOM MOLDERS OF ALL
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Member, Committee on
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EDITORIAL

Plastics Tools for a New Era

Three facets of our present consumer economy are obvious: a) the accelerated improvement of durable goods—refrigerators, automobiles, washing machines, etc.—to the end that models become obsolete faster; b) the creation of increased variety in designs and sizes of all types of these products, wide choice being a prime purchase incentive; and c) a universal need for lower labor costs in tooling.

We are prone to think of industry in this nation as mass-production enterprise, rolling out zillions of everything, the huge quantities and low costs being made possible by standardization. Actually, standardization in durable goods (which represent our largest personal outlays, aside from homes) is largely related to mechanical "innards"—motors, pumps, gears, and control devices.

One automobile manufacturer, making more than a million cars of one brand per year, features eleven main models. A refrigerator maker, producing half a million units a year has twelve styles in five sizes. Thus, in many cases, a few thousand units of one model may be a "run." While color changes can account for considerable flexibility in product appearance, contour of housing and detail of trim may account for more.

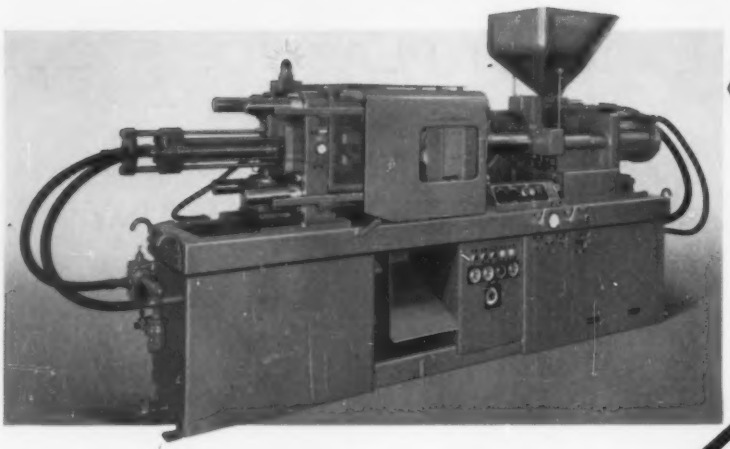
The lead article in our present issue deals with a most important and relatively new use of plastics in the manufacture of durable goods to meet the requirements of the new consumer economy: plastics tools for metal fabrication. Draw dies, restrike dies, stamping dies, jigs, and fixtures made of various plastics materials by various techniques are now coming into surprisingly broad use in the fabrication of everything from thin aluminum to 60-gage steel.

Results recorded to date indicate that for runs of up to several thousands, tool cost savings of up to two-thirds of the cost of steel tools may be obtained and the time required to produce a die may be at least halved. To the durable goods industry this development can mean greater flexibility in design, greater economies in tooling labor, immense savings in time. To the tool-making companies now embarking on the use of plastics in the production of these tools, it represents an opportunity, the like of which comes only once in a great many years. It is estimated that more than 15% of all forming tooling in 1954 will be done with plastics tools, compared to approximately 5% in 1953; the prospective growth pace for the future is even more impressive.

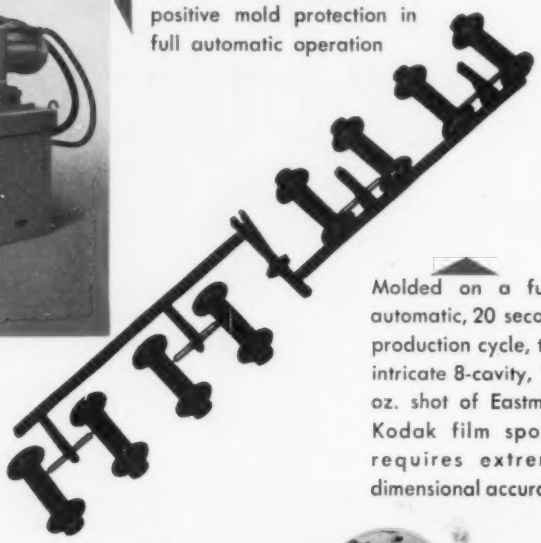
To the plastics industry this development must be something worth much close study. Already plastics dies are being tried out in long-run vacuum forming operations, plastics molds are functioning quite well in many low-pressure compression jobs, and heated plastics dies for short runs of large-area compression jobs are being built.

Full Automatic Molding "REED"

on NEW 175T-4/6 oz.



Reed-Prentice 175T-4/6 oz. injection machine with Low Pressure Die Closing unit for positive mold protection in full automatic operation



Molded on a fully automatic, 20 second production cycle, this intricate 8-cavity, 1½ oz. shot of Eastman Kodak film spools requires extreme dimensional accuracy

The 175T-4/6 oz. Reed-Prentice injection machine is rapidly earning a reputation for exceptional performance in full automatic and semi-automatic molding. In full automatic operation, a built-in low pressure die closing unit* effectively prevents any possible damage to the mold.

In the 175T-4/6 oz. "REED" you find the right combination of speed, ruggedness and capacity to economically mold complex parts to your most exacting requirements. The extra capacity of the 175T-4/6 makes it capable of handling jobs usually run on larger machines. **Optional*

For full details on the fast-cycling 175T-4/6, write for Bulletin #546.

"REEDS" available in 4, 6, 8, 12, 16, 20, 24, 32 and 48 oz. models

	175T-4/6	10D-8	300T-12/16	400T-16/20	450T-20/24	600T-32/48
pressure, tons	175	275	300	400	450	600
Mold clamping stroke	5-8"	10¼"	7½-12½"	8-14"	16"	24"
Platen size (WxH)	22 x 24¼"	21 x 25"	29 x 32½"	38 x 36"	45 x 48"	54 x 45"
Diameter of tie bars	3"	3¼"	4"	4½"	5"	6"
Space between bars	13½ x 13½"	11¼ x 14¼"	15 x 20½"	23½ x 23½"	22½ x 25½"	26½ x 30½"
Rated casting area, sq. in.	75	125	150	175	200	300
Plasticizing capacity, lbs. per hour	75	100	115	125	135	175
Dry Cycle time, seconds	6	12	10	14	18.6	32

Six-cavity thermostat base shot — a product of Minneapolis-Honeywell Regulator Co. — weighs 4½ oz. in high impact styrene, but is readily molded in 15 second cycle to close tolerances on a 175T-4/6 oz. "REED"

THE WORLD'S LARGEST MANUFACTURER OF INJECTION MOLDING MACHINES

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LARGE AREA MOLDING

with Celanese* Marco* Resins

can give you new design freedom

This one piece, reinforced plastic truck front gives the fleet owner all the distinction and other advantages of a special body job. But, because of the simplicity of its die construction and the low pressure bag method of molding, this truck front can be produced in long or short runs—economically.

The simplicity of large area molding opens up opportunities for nearly every industry. Already, there are hundreds of out-sized products: car bodies, tank trailers, furniture and pleasure boats now being produced better, stronger and often at lower cost through the use of reinforced Marco resins.

Marco resins produce molded structures with excellent resistance to hot and cold weather, corrosion, moisture, vibration, impact and stress. As with this truck front, color can be molded in. Patch repairs can be made by an amateur.

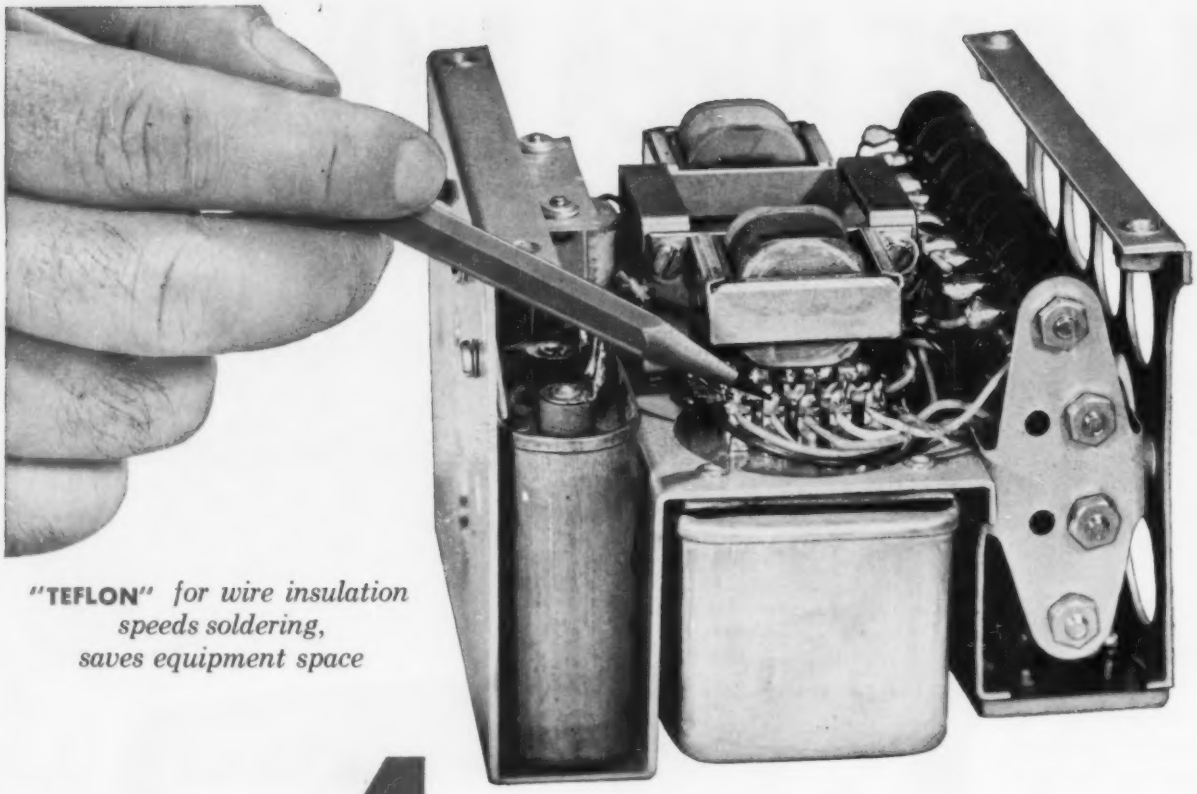
Marco resins can give you greater freedom of design, greater strength and construction simplicity. Write for the new Marco brochure. It is prepared for your benefit by the pioneer in polyesters.

Celanese Corporation of America, Marco Products
Dept. 101-I, Plastics Division, 290 Ferry Street,
Newark 5, N. J.
Canadian affiliate, Canadian Chemical Company
Ltd., Montreal and Toronto.

● Marco resin truck front manufactured by General Body Manufacturing Company, West Pennway and Summitt Streets, Kansas City, Missouri. It is part of assembled plastic body.

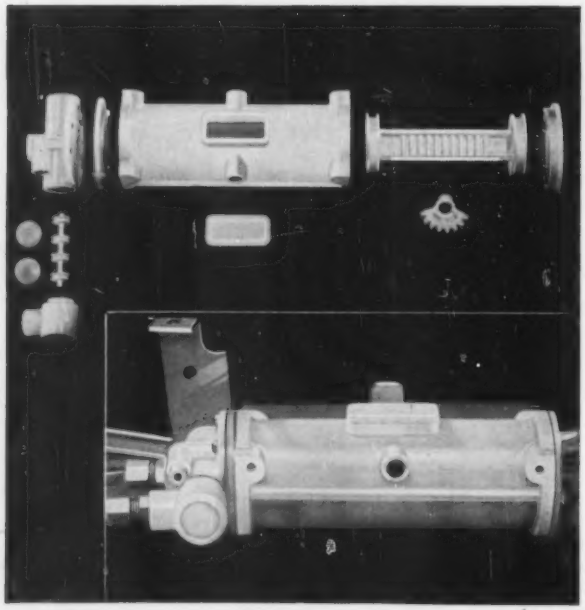
Celanese* PLASTICS

*Reg. U. S. Pat. Off.



"TEFLON" for wire insulation speeds soldering, saves equipment space

4 more examples of



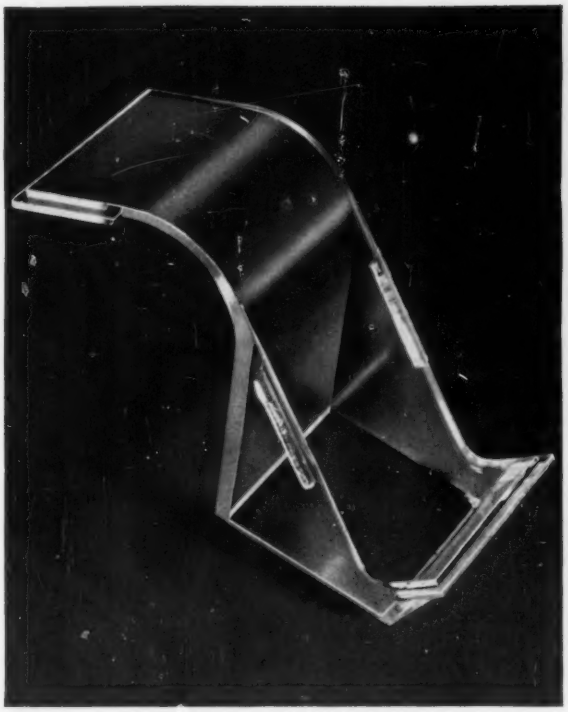
"ZYTEL" for windshield-wiper motor which gives longer service, needs no surface finishing

HERE IS CREATIVE ENGINEERING—brought about through the use of the Du Pont family of engineering materials. They help to simplify design, to lower production costs, and to improve performance of hundreds of different products. For example:

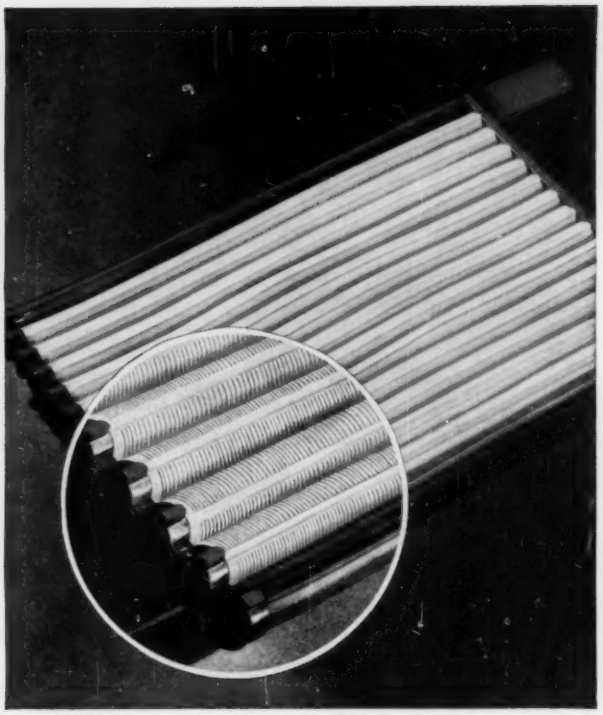
"TEFLON"* tetrafluoroethylene resin makes an exceptionally fine insulating material for miniaturized electrical equipment. Hookup wires coated with "Teflon" occupy only about one-third the space of materials providing comparable dielectric strength. Moreover, soldering of component metal parts in small, closely fitted terminals is easier because hot irons can't burn "Teflon." This engineering material has excellent thermal stability between —90° C. and 250° C., is extruded into wire coatings rapidly and economically.

"LUCITE"* acrylic resin makes this business-machine part transparent, wear-resistant and rigid. This part of "Lucite" permits a clear, uncluttered view of the business operation, and is easy to keep clean. Its sparkling good looks heighten sales appeal. Fabrication of these parts by injection molding is efficient and economical.

"ALATHON"* polyethylene resin is extruded and slotted as tubes for positive battery plates. Tubes are slotted so



"LUCITE" for business-machine parts is shatter-proof, transparent



"ALATHON" for slotted battery tubes which pack more power, give longer life

advanced product engineering

that more of the active material around the core is exposed to the electrolyte – battery has more power. Working life of the battery is also increased because this slotted construction retains more of the active material during the charge-discharge cycle. "Alathon" resists corrosion from the electrolyte and erosion from the electrolytic action. Parts are lightweight and strong.

"ZYTEL"† nylon resin is used for all eleven parts of this new air-pressure-type wiper motor. The moving parts showed no perceptible wear after a 9,500,000-cycle test. The motor will not corrode, and is dimensionally stable. "Zytel" makes the motor light in weight without sacrificing strength. The manufacturer can injection-mold an excellent mechanical surface for handling moving seals without expensive refinishing.

Investigate the properties of the Du Pont family of engineering materials. The applications described on these pages are typical of the product improvement possible when design and service requirements are evaluated in terms of these unique engineering materials. For further information on properties and uses, clip the coupon or write to E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Department, Room 309 Du Pont Building, Wilmington 98, Delaware.

DU PONT

REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING
. . . THROUGH CHEMISTRY

**Registered trade-mark of E. I. du Pont de Nemours & Co. (Inc.).*
†"Zytel" is the new trade-mark for Du Pont nylon resin.

E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Dept., Room 309 Du Pont Building, Wilmington 98, Delaware.

Please send me more information on the Du Pont engineering materials checked: ☐ "Teflon" tetrafluoroethylene resin; ☐ "Lucite" acrylic resin; ☐ "Alathon" polyethylene resin; ☐ "Zytel" nylon resin. I am interested in evaluating these materials for

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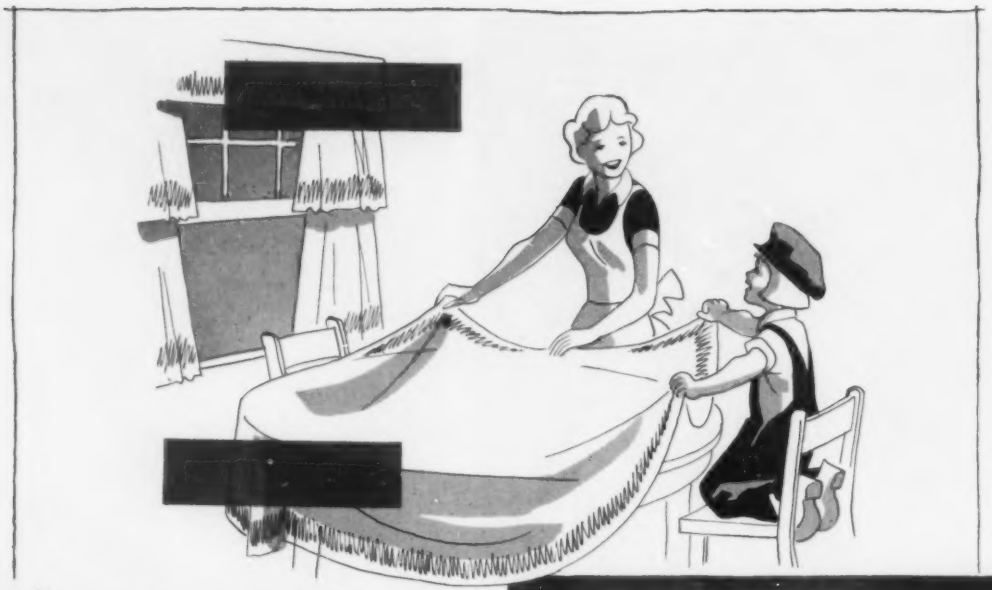
Type of Business_____



Why it pays to stabilize vinyl film and sheeting...

with "Dutch Boy" Plumb-O-Sil C

There are three pay-offs for you, when you stabilize your vinyl film and sheeting compounds with "Dutch Boy" Plumb-O-Sil C.

First . . . you're sure of good clean color. With most dyes and pigments, Plumb-O-Sil C enables the compounder to obtain deep shades and vivid colors. Because it has no appreciable tinting strength, Plumb-O-Sil C does not affect color values.

Second . . . you're sure of highly translucent film stock. That's because Plumb-O-Sil C's refractive index closely approximates that of vinyl chloride resins.

Third . . . you're sure of two processing advantages. Heat stability is good . . . pre-dispersion is unnecessary.

For an extra pay-off . . .

Plasticize with one of the three great, new "Dutch Boy" double-duty Primary Plasticizers that combine both low temperature flexibility and low volatility. Or with one of the four new, high purity, standard "Dutch Boy" Plasticizers. They team up with "Dutch Boy" Stabilizers, help reduce cost and simplify processing of vinyls.

For more data on "Dutch Boy" Stabilizers and Plasticizers, for technical application help, just write.

"Dutch Boy" Stabilizers

PRODUCT	USE
TRIBASE (Tribasic Lead Sulphate)	Electrical and other compounds requiring high heat-stability
TRIBASE E (Basic Lead Silicate Sulphate Complex)	Low volume cost insulation
DS-207 (Dibasic Lead Stearate)	Stabilizer-lubricant for sheeting, film, extrustion and molded compounds
PLUMB-O-SIL A (Co-precipitate of Lead Orthosilicate and Silica Gel)	Translucent and colored sheeting and upholstery stocks
PLUMB-O-SIL B (Co-precipitate of Lead Orthosilicate and Silica Gel)	Translucent and colored film, sheeting, belting
PLUMB-O-SIL C (Co-precipitate of Lead [illegible])	Highly translucent film and sheeting
DYTHAL (Di-basic Lead Phthalate)	General purpose stabilizer for heat and light. Good electrical properties
DYPHOS (Di-basic Lead Phosphite)	Outstanding for heat, light, weathering, in opaque stocks including plastisols and organosols
NORMASAL (Normal Lead Salicylate)	As stabilizer or co-stabilizer in vinyl flooring and other compounds requiring good light-stability
BARINAC (Barium Ricinoleate)	Stabilizer-lubricant for clears
CALSTAR (Calcium Stearate)	Where non-toxicity and lubricity are required
LEADSTAR (Lead Stearate)	As lubricant and co-stabilizer

Dutch Boy* CHEMICALS*

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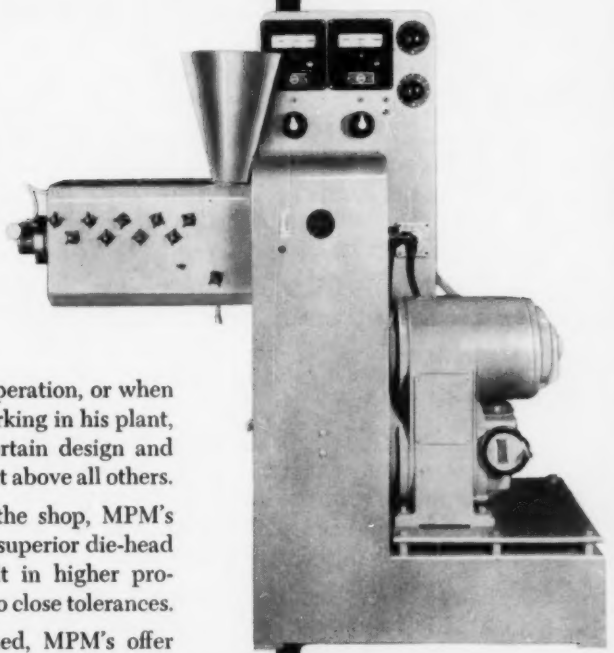
Don't believe them when they say:

It's built just like an MPM



Since all extrusion machines are basically alike, consisting of a motor, a hopper, heating devices, a screw, and a die-head... some people get the idea they all *perform* identically. Nothing could be further from the truth.

When you see an MPM extruder in operation, or when you question somebody who has one working in his plant, you will discover that an MPM has certain design and construction features which recommend it above all others.

From the viewpoint of the man in the shop, MPM's exceptional heating and cooling system, superior die-head construction, and powerful drive result in higher production of all manner of extrusions, held to close tolerances.

As far as plant owners are concerned, MPM's offer trouble-free operation, solid corrosion-resistant wearing parts which guarantee long service, and *built-in* flexibility, of great value now and of increasing value as new plastics materials are developed.

It's easy to be misled by superficial resemblances. Before deciding on an extruder for producing flat sheet, wide films, cross-sections, covered wire or some other item, investigate the high productive capacity and additional advantages for which MPM extruders are noted.

This is the 1½" MPM extruder. Other sizes available are 2½", 3½", and 4½". MPM also supplies auxiliary equipment such as wind-ups for flat and blown film, wire covering, monofilaments, dryers, granulators, pelletizers and so forth.

West Coast Representative
4113 West Jefferson St., Los Angeles 16, Calif.

modern plastic machinery corp. mpm

15 Union St., Lodi, N. J., U. S. A.
Cable Address: MODPLASEX

FINER FLOORING IS MADE FASTER

with new, dry blending PLIOVIC DB80V

FASTER mixing and a shorter heat history are the basic advantages of making flooring with dry blending PLIOVIC DB80V. These, in turn, lead to other benefits in the forms of greater total throughput, better development of cleaner colors, improved heat and light stability, less deterioration of physical properties and longer service life.

PLIOVIC DB80V is a straight polyvinyl chloride resin. But it's tailor-made to provide the properties needed in a good, dry blending resin. It absorbs plasticizer at a rapid, uniform rate. It gives a sandy, free-flowing mix that does not pack or bridge. And it does so with no sacrifice in processing characteristics or physical properties.

PLIOVIC DB80V is no happy accident, but the result of much research and development and carefully controlled production. The secret of its success as a dry blending resin lies in the close control exercised over its particle size, structure and distribution. Particles of DB80V are dry, free-flowing, irregular in surface and remarkably uniform in size.

Three other features of PLIOVIC DB80V which flooring makers find to their liking are its high degree of uniformity, its excellent heat stability and its thorough fluxing. These add up to more capacity on existent equipment and more consistent production with fewer rejects.

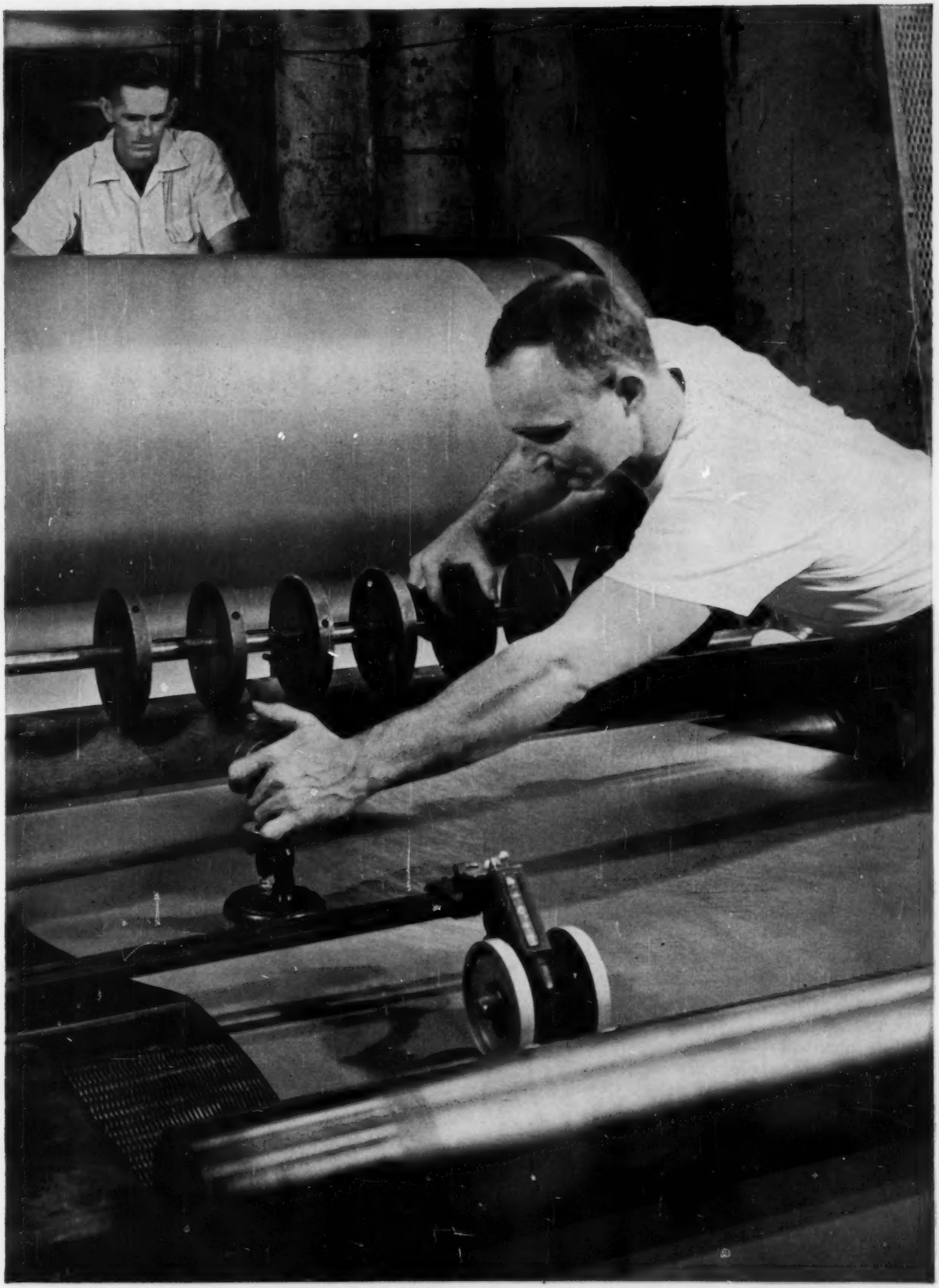
PLIOVIC DB80V is new, but not untried. It has fully proved its mettle in many tests and trial runs and in actual production. Why not let it prove itself in your plant? Samples and technical help are yours for the asking. Just write to:

Goodyear, Chemical Division, Akron 16, Ohio

CHEMICAL GOODYEAR DIVISION

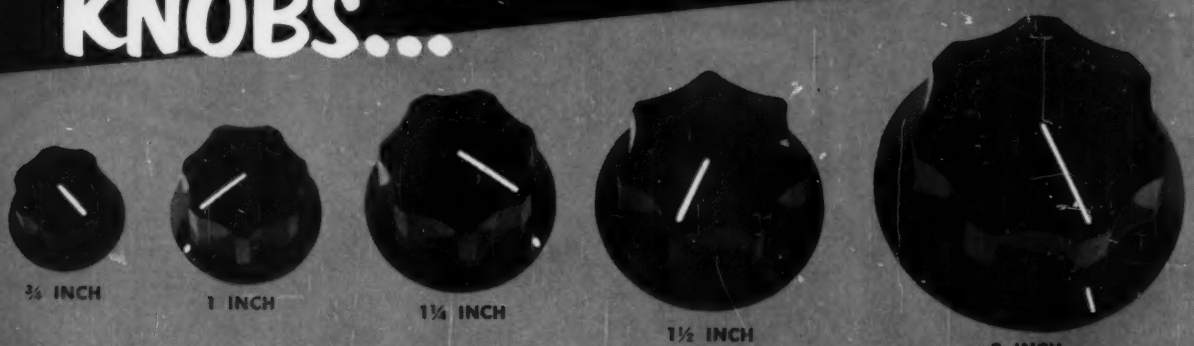
Chemigum, Pliobond, Pliolite, Plio-Tuf, Pliovic—T. M.'s The Goodyear Tire & Rubber Company, Akron, Ohio

Use-Proved Products—CHEMIGUM • PLIOBOND • PLIOLITE • PLIO-TUF • PLIOVIC • WING-CHEMICALS—The Finest Chemicals for Industry



TURNING OUT TOP QUALITY flooring is easier, faster, more profitable with PLIOVIC DB80V — the new, dry blending polyvinyl chloride resin.

KNOBS...

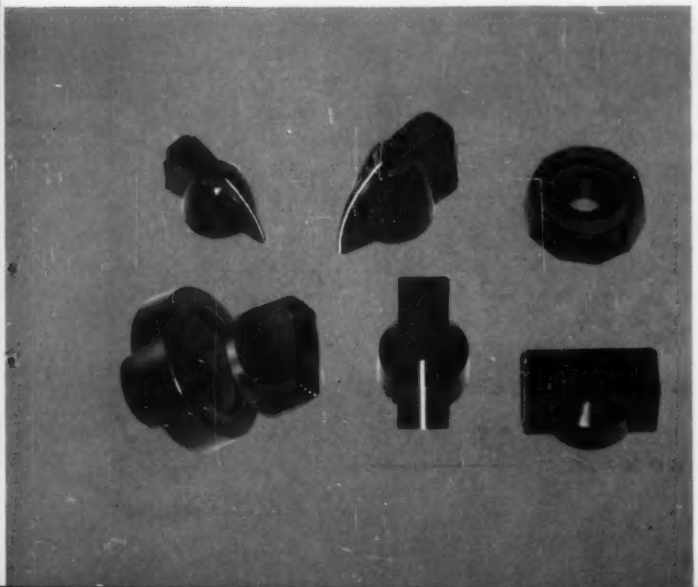


A New All-purpose Functional Design In a Standard Line of Instrument Knobs

Now, without tooling charge of your own, you can dress up your instrument line with these beautifully designed, readily available knobs by Kurz-Kasch.

Look them over! Shown actual size, dimensions given are flange diameters. All sizes have ¼" shaft holes—come with or without brass inserts—any type of setscrew (one or more). Undersides are counterbored. Color, metalized, and filled or unfilled indicator lines at your option. Here's style at a price!

Turn to Kurz-Kasch for the most complete line of standard knobs in the industry—and SAVE. Send for samples and specification data today—or request full line data on knobs not shown. Inquiries answered at once.



Don't overlook these popular Kurz-Kasch designs for bar knobs, pointer knobs and dual control vernier knobs.

KURZ-KASCH

Specialists in Thermo-Setting Plastics for 37 years

Kurz-Kasch, Inc. • 1415 S. Broadway • Dayton 1, Ohio

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EXPORT OFFICE: 89 Broad St., New York City, Bowling Green 9-7751.

make sales rise, too, with Titanox®-pigmented plastics

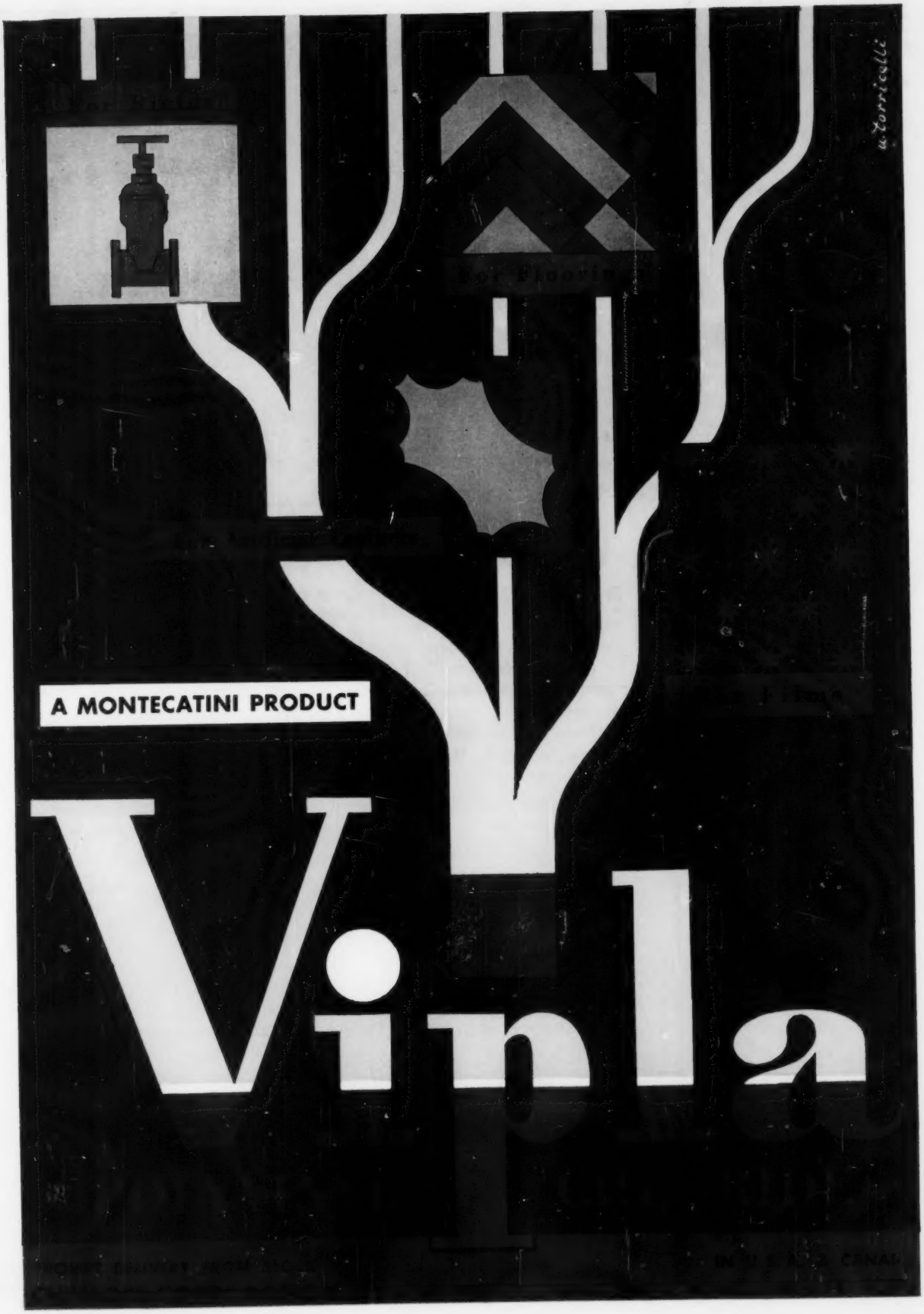
Clock radios, in soft tinted and white plastics, are introducing everywhere the pleasure of rising to music. Light colors that blend with boudoir decorations are easy-on-the-eye and vigorous sales producers that make cash registers sing.

TITANOX titanium dioxide white pigments are applicable to any type of plastic... phenolics, vinyls, polystyrenes, cellulosics. Selection of the proper pigmentation to achieve a specific property may indicate a special type of TITANOX pigment. TITANOX-RA will give maximum whiteness at minimum loading, while TITANOX-RCHT can be used at higher total pigment loading or in tints where the exceptionally high opacity of the "pure" titanium dioxide pigment is not needed.

If you have a plastic pigmentation problem, consult with our Technical Service Department. Titanium Pigment Corporation, 111 Broadway, New York 6, N. Y.; Atlanta 2; Boston 6; Chicago 3; Cleveland 15; Los Angeles 22; Philadelphia 3; Pittsburgh 12; Portland 9, Ore.; San Francisco 7. In Canada: Canadian Titanium Pigments Limited, Montreal 2; Toronto 1.

®TITANOX
the brightest name in pigments

2238
TITANIUM PIGMENT CORPORATION
Subsidiary of NATIONAL LEAD COMPANY


A MONTECATINI PRODUCT
Vinla

FULL HYDRAULIC CLAMP • PLENTY DAYLIGHT & STROKE

All New HPM

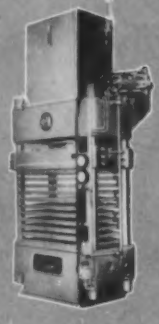
ACCESSIBLE POWER UNIT • HIGH SPEED INJECTION • BIG PLATENS

Reinforced Plastics Presses

●A complete line of stock presses from 50 to 200 tons, designed specifically for molding reinforced plastics. Larger sizes built to order.

Write for Bulletin No. 5404!

Laminating Presses



● Multiple hot plate presses with steam or electrically heated plates for compressing or curing laminated materials. Built to customer's requirements.

THE WORLD'S *MOST COMPLETE LINE* OF PLASTICS INJECTION MACHINES!

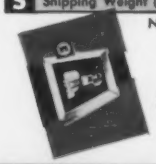
From 6 ounces to 400 ounces with mold clamping forces from 150 to 3000 tons . . . that's H-P-M's new line! Here is by far the largest and most comprehensive group of injection molding machines ever offered to the plastics industry! Automatic machines . . . pre-plasticizing machines . . . conventional semi-automatic machines . . . every one a proven design with faster speeds . . . greater production output. Truly, H-P-M offers you the most modern production machinery available anywhere!

Each machine is NEW . . . designed with so many outstanding improvements that even the most experienced injection molder will be amazed. Talk to an H-P-M plastics engineer today!

SPECIFICATIONS

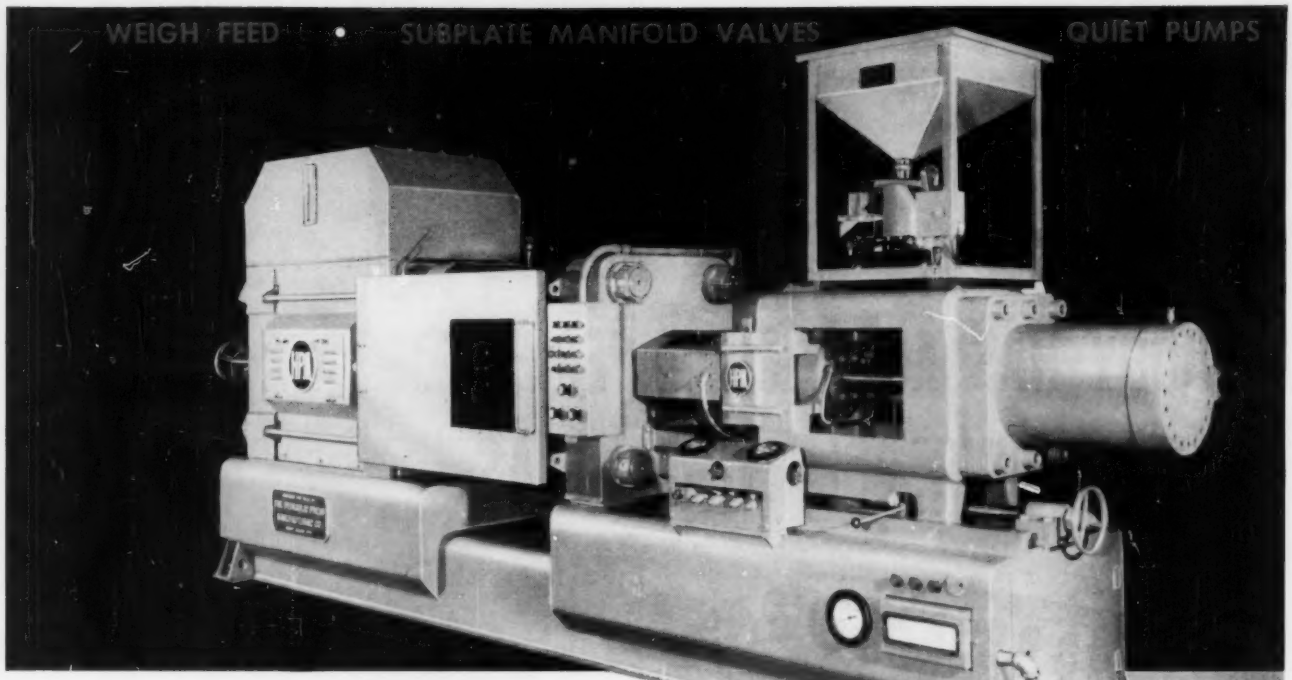
STANDARD INJECTION MACHINES					
MODEL NUMBER	150-H-6	300-H-12	400-H-20	800-H-48	1200-H-80
Capacity (Oz.—Single Feed)	6	12	20	48	80
Capacity (Oz.—Double Feed)	8	16	28	64	100
Material Injected (cu. in. per min.)	440	1035	1330	2895	2850
Plasticizing Capacity (lbs. per hr.)	60	100	135	300	400
Mold Clamp Capacity (tons)	150	300	400	800	1200
Mold Space (hor. x vert.): (a) Full Platen Vertically	10½"x25"	16½"x33"	20½"x 42"	36"x54"	40"x68"
(b) Full Platen Horizontally	20½"x15"	30"x20"	36"x26½"	54"x36"	60"x48"
Daylight Opening without Ram Spacer	20"	30"	40"	55"	60"
Daylight Opening with Ram Spacer	16"	26"	34"	47"	48"
Mold Thickness without Ram Spacer	10"	10"	15"	20"	24"
Mold Thickness with Ram Spacer	6"	6"	9"	12"	12"
Clamp Travel (max.)	10"	20"	25"	35"	36"
Motor Horsepower	20	40	50	100	100
Shipping Weight (pounds)	14,500	22,000	39,000	75,000	125,000

NOTE: All ratings based on molding general purpose polystyrene.



Write for Bulletin #5406 Today!

THERE'S AN H-P-M TO MOLD IT—



Check these Features:

FULL HYDRAULIC MOLD CLAMP — provides fast closing and opening speeds with automatic adjustable slow downs. No adjustments required for different mold thicknesses, which mean big savings in mold set-up time.

EXTRA-LARGE PLATENS — will accommodate big molds . . . located at ideal operator height, requiring no platforms or pits.

ACCURATE, COMPENSATING WEIGH FEEDER — is standard equipment on all conventional, large capacity models.

PLENTY DAYLIGHT & STROKE — permit production of deep parts. Quick changing ram spacer permits use of thin molds without bolsters.

OVERHEAD OIL TANK — keeps oil clean and provides gravity prefill for fast clamp pressure build-up.

HIGH-SPEED INJECTION UNIT — combines new high-output, 3-zone plasticizing chamber with injection plunger speeds over 50% faster than on previous models. Entire injection unit can be retracted hydraulically.

NEW H-P-M HYDRAULIC CIRCUIT — employs exceptionally quiet pumps and a new leakproof manifold sub-plate valve system which reduces hydraulic piping to a minimum.

PRE-PLASTICIZING INJECTION MACHINES					
MODEL NUMBER	400-P-48A	1200-P-200	1200-P-200A	3000-P-200A	3000-P-400A
Capacity (Oz.—Single Feed)	48	200	200	200	400
Capacity (Oz.—Double Feed)					
Material Injected (cu. in. per min.)	1340	6950	3000	6950	7200
Plasticizing Capacity (lbs. per hr.)	180	400	400	600	600
Mold Clamp Capacity (tons)	400	1200	1200	3000	3000
Mold Space (hor. x vert.): (a) Full Platen Vertically (b) Full Platen Horizontally	21½"x 40" 36"x25½"	40"x68½" 60½"x 48"	40"x68½" 60½"x 48"	49"x88" 49"x88"	49"x88" 49"x88"
Daylight Opening without Ram Spacer	54"	60"	60"	60"	108"
Daylight Opening with Ram Spacer	46"	48"	48"	48"	84"
Mold Thickness without Ram Spacer	24"	24"	24"	30"	48"
Mold Thickness with Ram Spacer	16"	12"	12"	18"	24"
Clamp Travel (max.)	30"	36"	36"	30"	60"
Motor Horsepower	50	355	175	355	355
Shipping Weight (pounds)	46,000	154,000	143,000	264,300	324,300

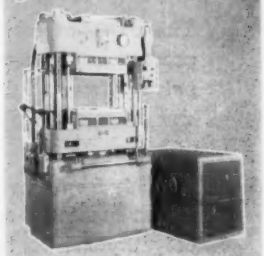
NOTE: All ratings based on molding general purpose polystyrene.

THE HYDRAULIC PRESS MFG. COMPANY

Mount Gilead, Ohio, U. S. A.

Cable Address—"HYDRAULIC"

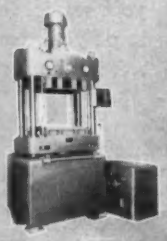
Transfer Presses



● Stock sizes 100, 200, 300 and 500 tons. Larger sizes up to 2500 tons built on special order.

Write for Bulletin No. 4901!

Compression Presses



● Stock sizes 100, 200, 300 and 500 tons. Larger sizes up to 2500 tons built on special order.

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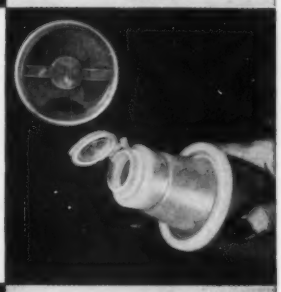
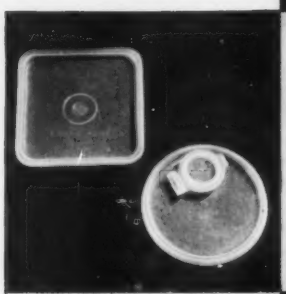
Better . . . Faster . . . and at Lower Cost!

NOBODY HAS AS MUCH EXPERIENCE AT MOLDING POLYETHYLENE AS TUPPER!





Tupper Seals are air and liquid-tight flexible covers. The famous Pour All and Por Top covers are designed for easy dispensing. They are made in sizes to fit all Tupperware containers.

When equipped with Tupper Seals, Tupper Canisters, Sauce Dishes, Wonder Bowls, Cereal Bowls and Funnels in various sizes are the most versatile reusable containers you have ever seen.

The logical molder for you to consult regarding that product or package of yours which is to be made of polyethylene is Tupper. Tupper has done more than any other molder to make molded polyethylene a practical reality.

Aside from having designed, patented, and promoted successful seals, closures, and dispensers for polyethylene containers, the Tupper Corporation has vast experience in *every phase* of polyethylene packaging and polyethylene injection molding. This experience will be of major importance in improving your product, in reducing your costs, when Tupper goes to work for you.

Tupper's combination of experience, technical ingenuity, and the most modern equipment is at your service for the custom molding of your product in polyethylene. You can do no better than the best ...and the best at molding polyethylene is Tupper!

TUPPER! TRADE MARK

TUPPER PRODUCTS ARE FULLY PROTECTED

About 150 United States and foreign patents and patents applied for, plus numerous trademarks and copyrights, cover the design and manufacture of the various types of Tupper Seals and other Tupper Products. Unauthorized manufacture of items covered by Tupper patents will subject infringers to prosecution.

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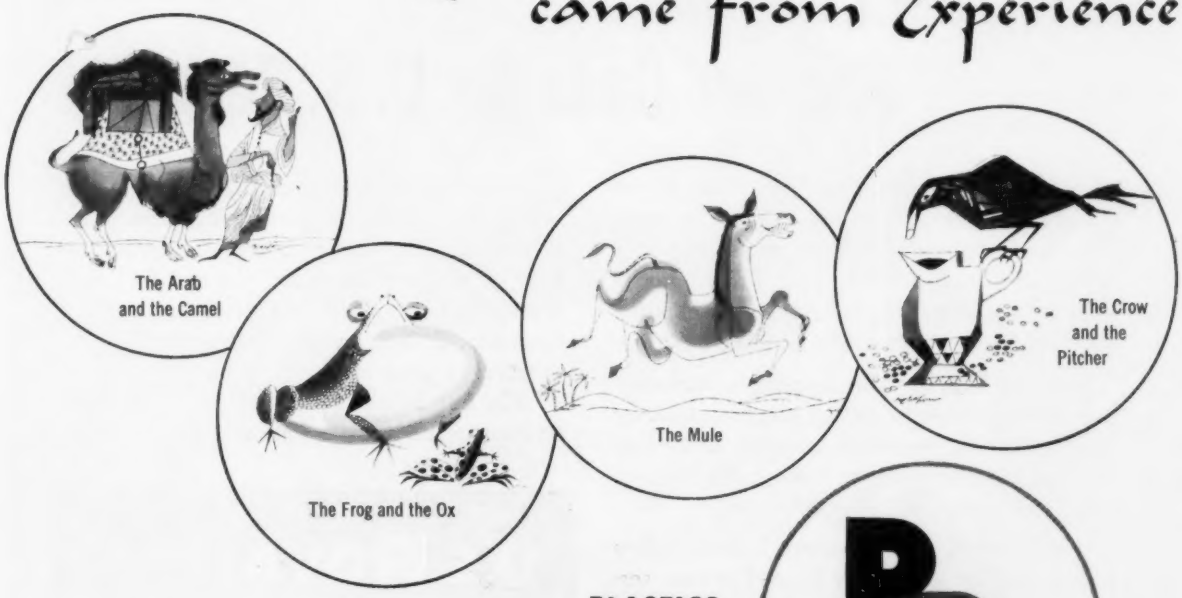
Manufacturers of — CONSUMER, INDUSTRIAL, PACKAGING AND SCIENTIFIC PRODUCTS

Factories, Laboratories and Sales Offices.
Farnumsville, Mass., Blackstone, Mass.
Orlando, Fla., Montreal, P. Q.
Showrooms: 225 Fifth Ave., N. Y. C.
Address All Communications To: Dept. M-9

Aesop was supposedly a Greek slave who had been bought and sold several times. It was in the course of his travels, the various predicaments in which he found himself and his reactions to them, that he gained the reputation for having great wisdom and a mighty wit. His fables, which were unrecorded, were handed down by word of mouth from generation to generation — thus gaining him immortality. Such is the legend of Aesop.

Plenco, long a leading supplier of a wide range of quality controlled phenolics to the plastics industry, places their great experience and engineering wisdom at your disposal to help you solve your most complex problems.

Aesop: his Wisdom came from Experience



PLASTICS ENGINEERING COMPANY
Sheboygan, Wisconsin

PLENCO PHENOLICS
FOR BETTER PLASTIC PRODUCTS

Silvertone Radio sold exclusively by Sears, Roebuck and Co. U.S. Royalite case molded by Durable Formed Products, N. Y. C.

Handy, hardy & handsome

Another Case for U. S. Royalite!

Time was when a "portable" radio was about as easy to carry as a suitcase. But this one's actually "pocketable"! *New materials,* like midget-size radio tubes, and tough, lightweight *U. S. Royalite,* make this marvelously compact Sears, Roebuck & Co. radio possible.

This new U. S. Royalite housing is extremely thin and lightweight, yet so tough and hardy it defies breakage—even if dropped! And it has a richly grained surface, with built-in color that can't peel, chip, or scratch off.

What's more, this attractive U. S. Royalite case is quickly and easily formed in two sections by matched metal molds – takes and *holds* sharp mold details for lasting beauty.

You can see the case for U. S. Royalite is a *strong* one. With its great toughness, high dimensional stability, resistance to most chemicals, clean good looks and pleasant feel, and ability to be as hard or flexible as the case demands, U. S. Royalite might well be just the solution to *your* case.

Why not find out about it? It's as easy as writing to the address below.

U.S. ROYALITE
TOUGH PLASTIC PRODUCTS

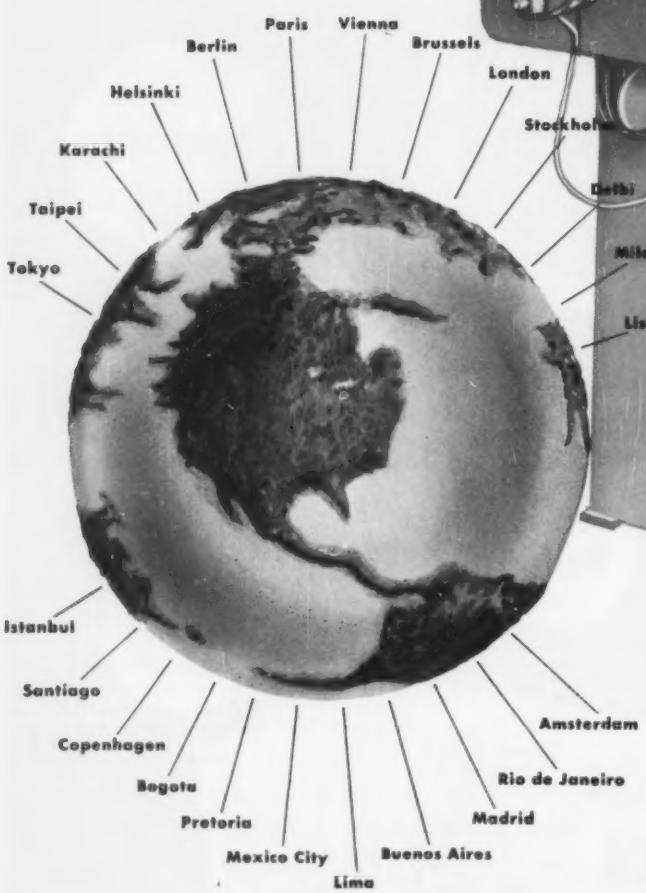
US RUBBER

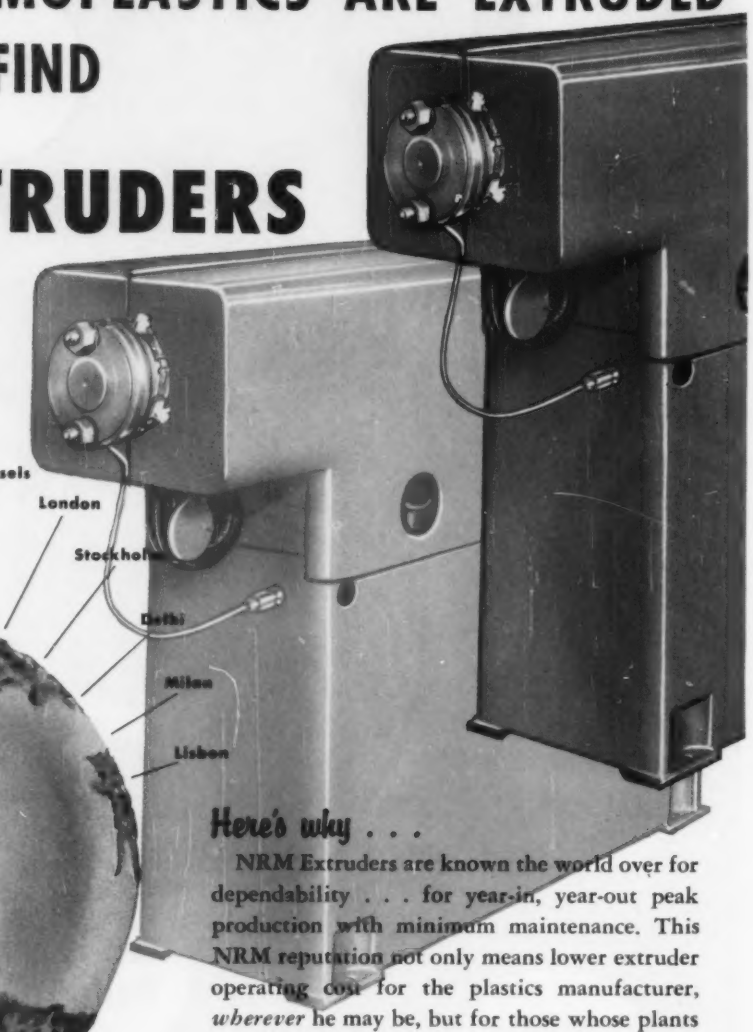
UNITED STATES RUBBER COMPANY
2638 NORTH PULASKI ROAD • CHICAGO 39, ILLINOIS

WHEREVER THERMOPLASTICS ARE EXTRUDED YOU'LL FIND

NRM EXTRUDERS

At work...





Here's why . . .

NRM Extruders are known the world over for dependability . . . for year-in, year-out peak production with minimum maintenance. This NRM reputation not only means lower extruder operating cost for the plastics manufacturer, *wherever* he may be, but for those whose plants are far from parts and service facilities, it offers a vital safety factor, as well. These are a few of the many reasons why plastics manufacturers overwhelmingly choose NRM Extruders.

A postcard will bring you full details on the engineering and operating features that make NRM plastics Extruders and equipment *preferred* the world over. Write for this information TODAY. Read the facts, and make *your* next extruder an NRM.

NATIONAL RUBBER MACHINERY COMPANY

NRM

Creative Engineering

General Offices and Engineering Laboratories, 47 West Exchange St., Akron 8, Ohio
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IF YOU USE *Crystal Urea*

(CARBAMIDE)

...Get Laboratory Purity at Process Prices!

If You Make or use plastics, plasticizers or resins (or for that matter, adhesives, coatings, plywood bondings, ceramics, dyes or wet-strength paper) you will want to investigate the advantages of Nitrogen Division Crystal Urea. Its quality is comparable to U.S.P. at no extra cost!

The Reason is plain enough: when you buy from Nitrogen Division, you are buying from the world's largest producer of high purity Urea . . . with ultra-modern production facilities at South Point, Ohio and Omaha, Nebraska.

Fast Delivery and Personalized Service: Stocks are maintained at convenient points to assure fast, on-time delivery—even on short notice. Why not arrange to schedule your first shipment today?

Delivery Points: South Point, Ohio and Omaha, Nebraska. L.C.L. from: Passaic, N. J., Chicago, Ill., South Providence, R. I., East St. Louis, Ill., Charlotte, N. C.

Shipped in 100-lb. moisture proof multi-wall bags.

FOR YOUR PROCESS—
U.F. Concentrate—85!

—the highest concentration of liquid formaldehyde commercially available—61% formaldehyde, 24% pure urea in water solution.

Costly excess water has been squeezed out. High costs too have been squeezed out. U.F. Concentrate—85 costs no more than less concentrated formaldehyde solutions. Send for informative booklet!

SEND TODAY!

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Ethylene Glycol • Diethylene Glycol
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Nitrogen Tetroxide • U.F. Concentrate—85
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☐ Please have your Technical Service Man call to discuss the economic application of Urea to our process. (No obligation.)

☐ Please send me a booklet describing U.F. Concentrate—85

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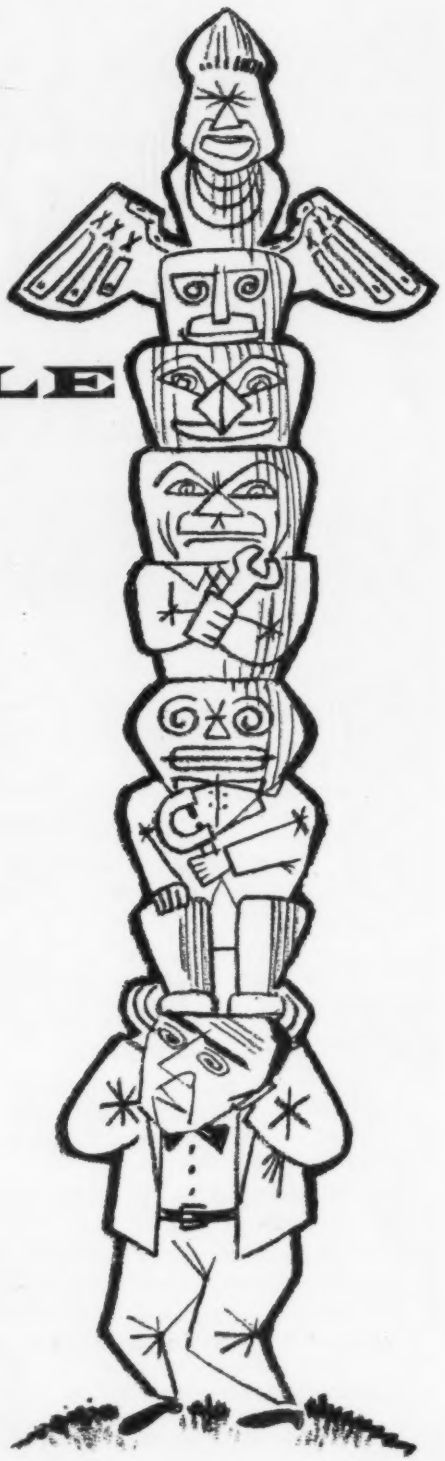
Title_____

Company_____

Address_____ MP-9

LOW MAN ON THE MOLD-UM POLE



Up the creek without a paddle—holding the mucky end of the stick—there are lots of ways of saying it.

The man in question has listened to some molder promise low prices, sensational deliveries, unexcelled quality, impossible tolerances. When the time comes and the molder lays an egg—who is hurt? Who is the low man, or what have you?

The buyer.

Moral—check your molder carefully, don't expect the impossible—and become the high man not the low man—It's easy—See Boonton.

You can watch your mold run at—

BOONTON MOLDING CO.

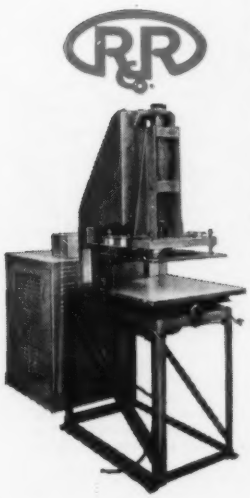
BOONTON, NEW JERSEY

NEW YORK OFFICE—CHANIN BUILDING, 122 EAST 42ND STREET, OXFORD 7-0155

PLASTICS WELDED BY THERMATRON FIT INTO EVERYBODY'S LIFE!

More and more vinyl plastic products welded electronically by THERMATRON are fitting into the pattern of our daily lives. The extra strength, beauty and wearing ability of such welded plastics as upholstery, drapes, window shades, place mats and food covers for the home . . . toys, wading pools and clothing for the younger set . . . aprons, wallets, handbags, raincoats and sportswear for adults . . . plus a wide range of industrial products, make them first choice of buyers.

If you're working on a new plastic product or want to improve an older one, consult us now. We'll run tests without obligation on your own materials and offer suggestions. Write for bulletin 87.



Thermatron®

HIGH FREQUENCY SEALING AND HEATING EQUIPMENT

Thermatron Division

RADIO RECEPTOR COMPANY, INC.

In Radio and Electronics Since 1922

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Chicago: 2753 West North Ave.
Los Angeles: Electroseal Plastics Co., 130 North Juanita Ave.
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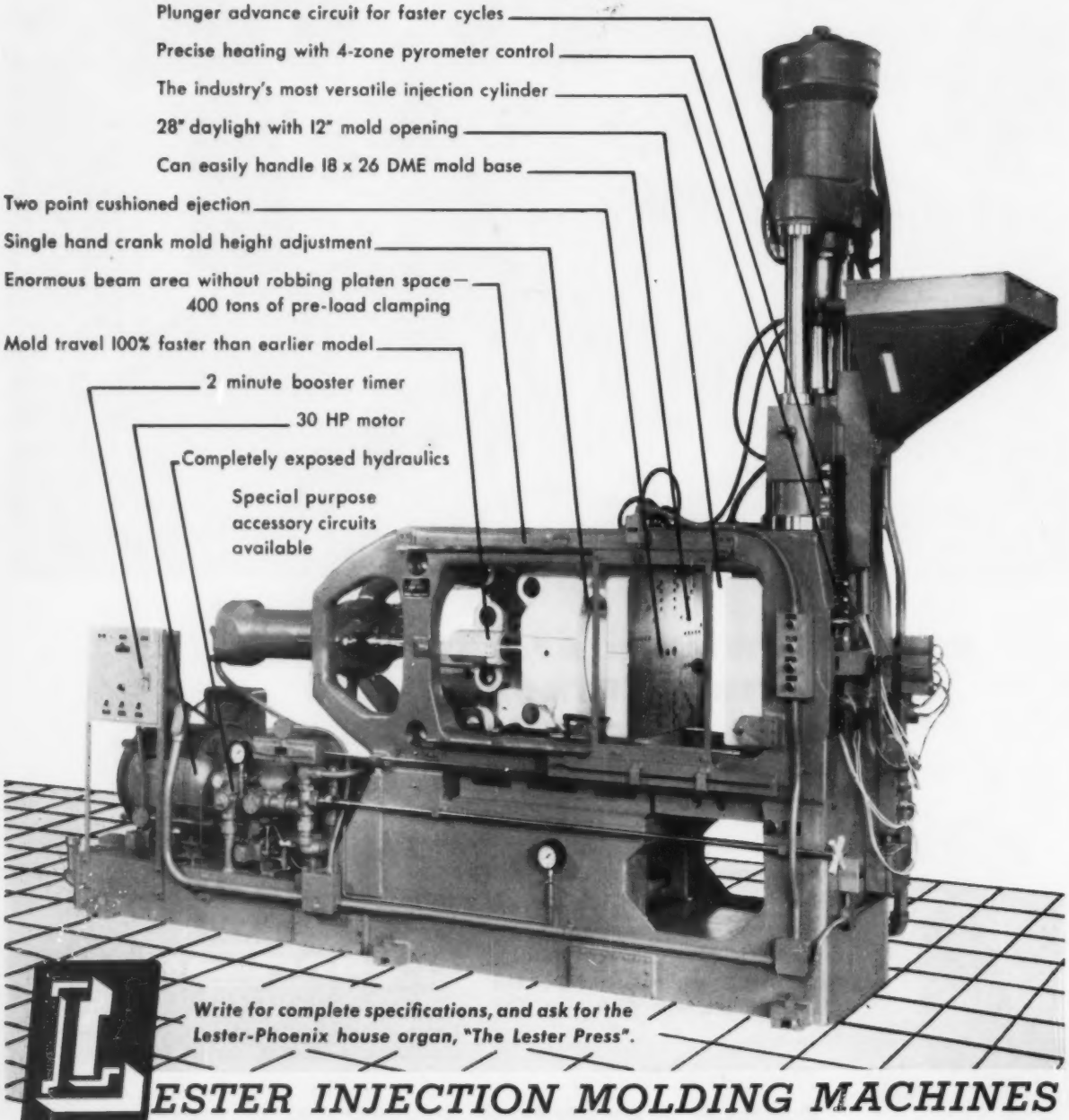
The NEW 12 OUNCE LESTER

With clamp and mold area greater than most other 16 and 20 ounce machines...



Write for complete specifications, and ask for the Lester-Phoenix house organ, "The Lester Press".

LESTER INJECTION MOLDING MACHINES

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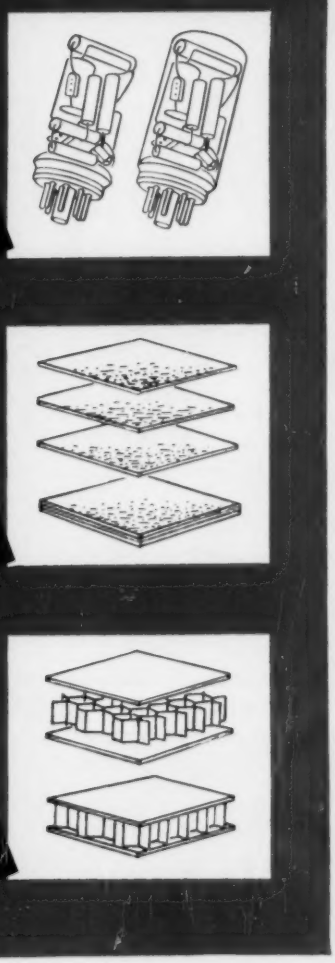
Tailor-Made Elastomeric Resins from *Thiokol*®

Liquid Polymers and Liquid Epoxies for...



The need for 100% reactive elastomeric liquid resins in many applications is being met by combinations of "Thiokol" liquid polymers with liquid epoxies. These combinations cure to elastomeric resins and can easily be tailor-made for specific requirements. By simple variations in the ratios of components, a broad range of properties can be developed.

"Thiokol"-epoxy combinations display advantages unobtainable with either material alone.

The processing characteristics are similar to those of liquid epoxies with the following additional advantages:

REDUCTION IN VISCOSITY • STABILIZED VISCOSITY AT HIGH TEMPERATURES
LOWER EXOTHERMIC TEMPERATURE RISE • LOWER SHRINKAGE
HIGH STRENGTH ROOM TEMPERATURE CURES • RELIEF OF RESIDUAL STRAINS

The basic properties of the epoxy resins, such as high strength, chemical inertness and dielectric characteristics are substantially retained. Additional desirable properties of the following type are developed:

HIGHER IMPACT STRENGTH • IMPROVED TEMPERATURE CYCLING PROPERTIES
MOISTURE AND GAS IMPERMEABILITY • HIGHER PEEL AND BEND STRENGTH

"Thiokol"-epoxy combinations are being used in an increasing number of potting, casting, laminating and adhesive applications. For information on the suitability of these new elastomer-resin combinations for your requirements, write:

Thiokol
Chemical Corporation

SYNTHETIC RUBBERS • PLASTICIZERS • CHEMICALS • SOLID PROPELLANTS

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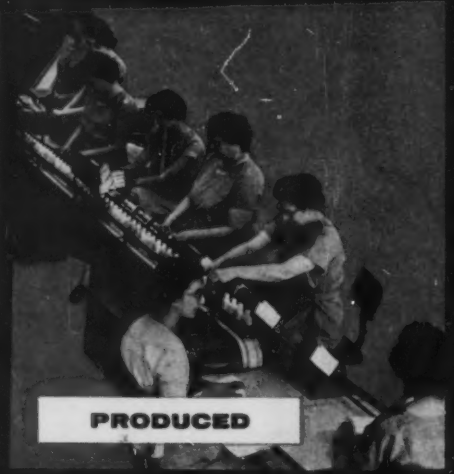
In Canada: Naugatuck Chemicals Division, Dominion Rubber Company, Elmira, Ontario

PRACTICALLY

ALL PRODUCTS ARE PACKAGED

AND ALL PACKAGES MUST BE...

DESIGNED



PRODUCED

MERCHANDISED

If you make anything that goes into packaging any product . . . for its design, production or merchandising . . . your advertising belongs in—

The liveliest squirt in packaging is the squeeze bottle. This flexible polyethylene container with a spray top is marketing baby lotions and hair slickers, car washes and deodorants . . . introducing more new ideas than you can shake a stick at. In fact, squeeze bottle production is spiraling to a 200 million high this year, and people in the field say it may go to 700 million!

Plastic packaging—of all kinds—has a rare quality of showmanship. It can be transparent or brilliantly colored, rolled in sheets, molded, punched or stamped out . . . in boxes, bags, bottles, wraps.

Inventive designers are using vast quantities of plastics . . . and paper, metals and fibre, too . . . in new ways, to package products for today's market, where the package works as protector, applicator, and salesman all rolled into one.

In all these facets of the field, MODERN PACKAGING has served the people who design, produce and merchandise packaging . . . helped them do a creative job , to sell more of practically everything — and *buy* a tremendous volume of materials, machines and supplies. It has lead the field for 26 years , and still does, by a wide margin, as survey after survey proves. Ask for the facts.

ABC AUDITED PAID CIRCULATION

MODERN PACKAGING

ABP BUSINESS PAPER LEADERSHIP

A BRESKIN PUBLICATION

575 Madison Avenue, New York 22, New York

KLEESTRON

Colorant Blend 604

the *VERSATILE* plastic

Talk plastics from London to Lagos, Birmingham to Brisbane, and very soon the topic will be polystyrene—cheapest, lightest, most adaptable moulding material. Talk polystyrene . . . and pretty soon you'll hear mention of Kleestron Colorant Blend 604. This most versatile of plastics is supplied as granules, fines or a mixture of both—each type eminently suitable for both dry colouring and extruded colouring.

Kleestron 604 pouring from a Hopper during a late stage of production.

All enquiries to—

KLEESTRON LIMITED

WEST HALKIN HOUSE · WEST HALKIN STREET · LONDON SW1 · ENGLAND

Cables; KLEEMABRO · LONDON Telephone: SLOane 0866

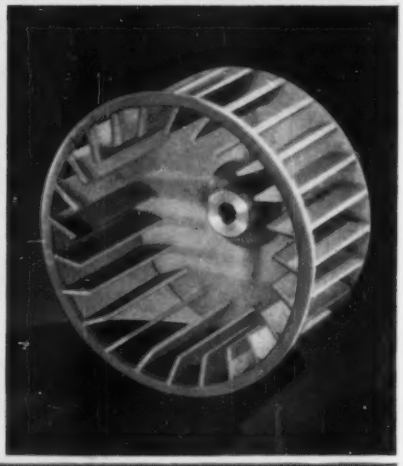
Fiberglas Reinforcements now in injection molding compounds

Can never warp

Because film reels must retain their shape permanently, American Molded Products Co. chose a Fiberglas-polystyrene molding compound for dimensional stability, compressive strength and controllable mold shrinkage.

Extremely strong and rigid

Admiral Photo Products' slide viewer, injection-molded by Moldrite of a Fiberglas-reinforced polystyrene, will not crack if dropped. The compound was selected for its high strength and molding stability.



Unaffected by heat

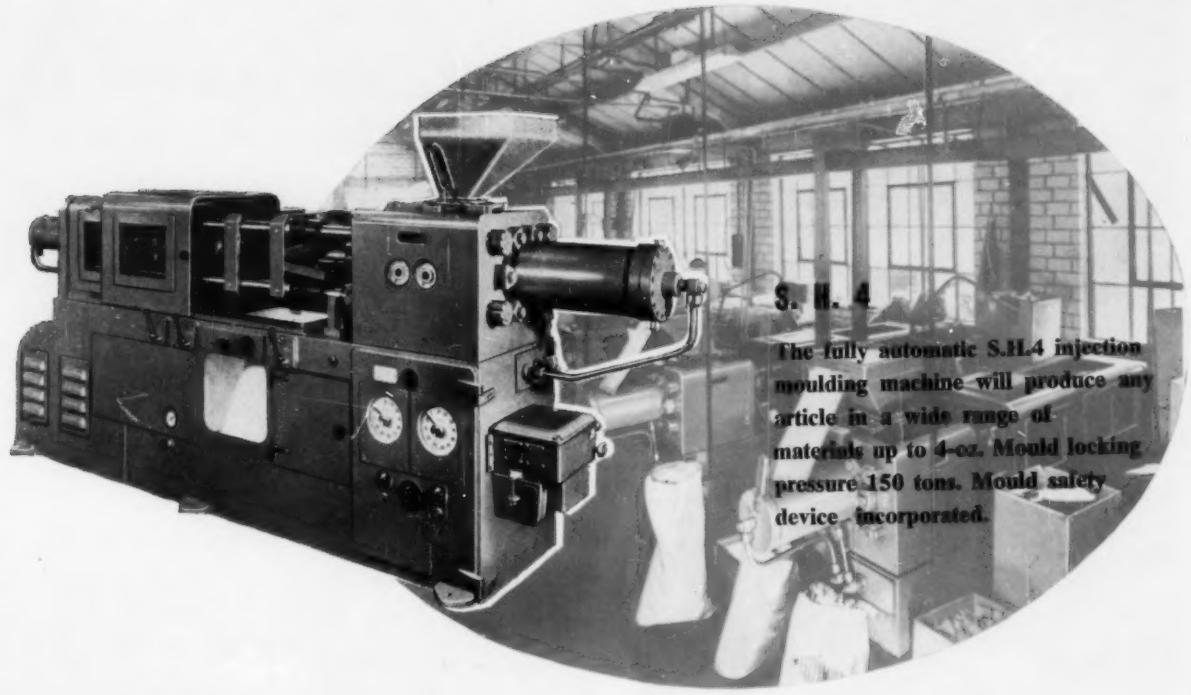
This *Plasturbo* fan for the Studebaker heater takes high temperatures in stride. Master Appliance Mfg. Co. turned to a Fiberglas-polystyrene molding compound for the high heat resistance required.

These three applications mark the first use of Fiberglas*-polystyrene molding compounds for fast, economical injection molding. All three products already have achieved notable success in field tests. They have proved that Fiberglas reinforcements give thermoplastics increased strength and rigidity, greatly improved dimensional stability and better control over mold shrinkage and warping. The molding compounds are now available from Koppers Co., Inc., Pittsburgh, Pa., and Fiberfil, Warsaw, Ind. For further information, write these firms or:

OWENS-CORNING FIBERGLAS CORPORATION
Plastics Reinforcement Div., 598 Madison Ave., New York 22, N.Y.

OWENS-CORNING
FIBERGLAS

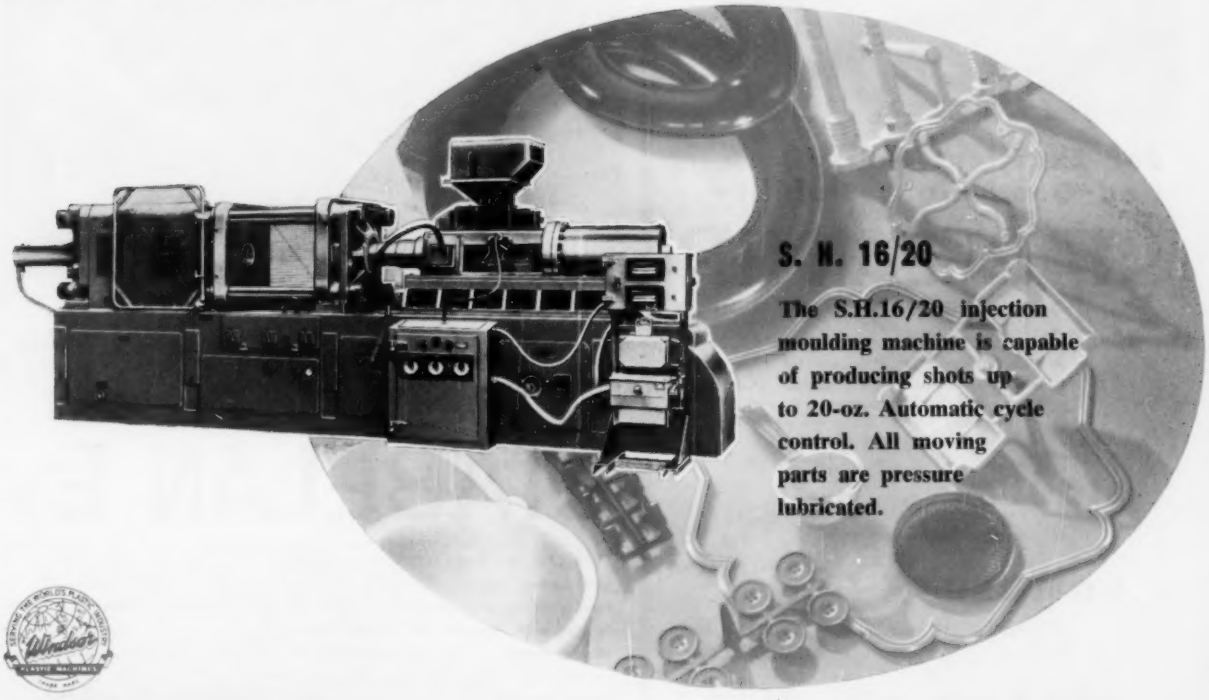
**Fiberglas is the trade mark (Reg. U. S. Pat. Off.) of Owens-Corning Fiberglas Corporation for a variety of products made of or with glass fibers.*



S. H. 4

The fully automatic S.H.4 injection moulding machine will produce any article in a wide range of materials up to 4-oz. Mould locking pressure 150 tons. Mould safety device incorporated.

INJECTION MOULDING



S. H. 16/20

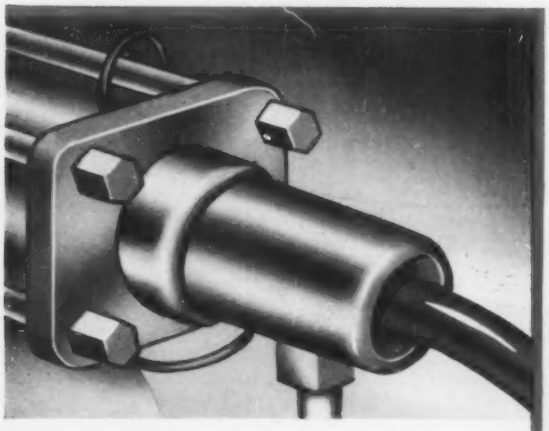
The S.H.16/20 injection moulding machine is capable of producing shots up to 20-oz. Automatic cycle control. All moving parts are pressure lubricated.

R.H. Windsor LTD

Office & Works
LEATHERHEAD ROAD • SOUTH CHESSINGTON • SURREY • ENGLAND
Head Office
49 Upper Brook Street • London W 1 • England

U.S.A. *F. J. Stokes Machine Co., Philadelphia 20, Pennsylvania*
CANADA *Wilmod Co., Plastic Division, 2488 Dufferin Street, Toronto*

FOR BETTER STABILIZATION
of Calendered Vinyls – Plastisols, Organosols, Emulsions
under Heat, Light, Ultra-violet and Aging . . .
THERE IS A
STABELAN



For Excellent Heat and Good Light Stability

STABELAN HR

PASTE - -

A "single package" stabilizer for high heat resistance plus good light stability . . . Contains cadmium and barium components and synergized chelating agent. Disperses easily in dry pre-blends, solutions and dispersions.

LIQUID - -

A synergized chelating agent.

POWDER - -

A metal bearing component of STABELAN HR paste.

STABELAN HR has been used with marked success in stabilizing all types of Vinyls containing organic and inorganic pigments.

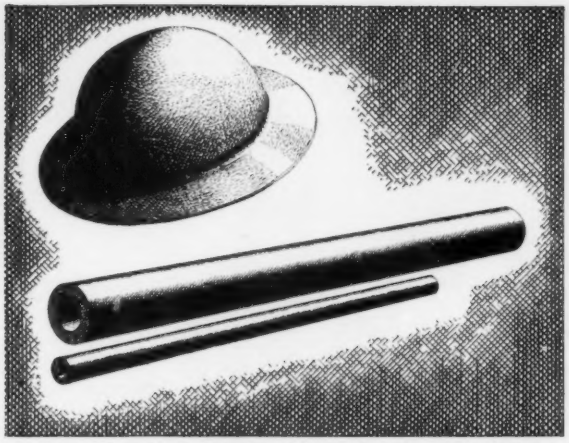
For Excellent Light and Good Heat Stability

STABELAN E

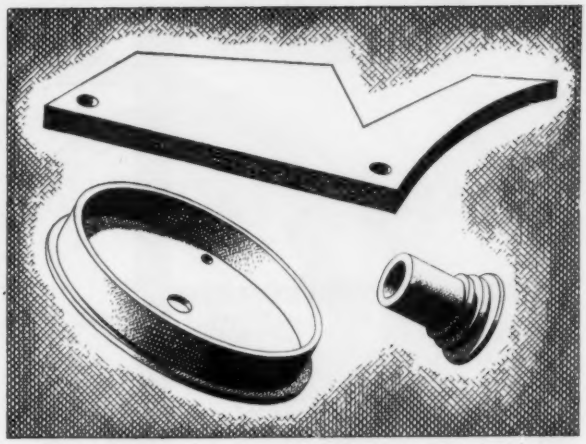
STABELAN E — Paste — Provides excellent stabilizing for ultra-violet and outdoor aging . . . It gives good light fastness and heat stability. Heat stability and transparency may be improved when Stabelan E is used with Stabelan HR Liquid. Gives films that do not "blush" or absorb water . . . It is compatible with all tested pigments — even organic reds hold their hue and age well . . . It does not cause plating on rolls.

Write for complete data on these materials.

HARWICK STANDARD CHEMICAL CO.
AKRON, BOSTON, TRENTON, CHICAGO, LOS ANGELES

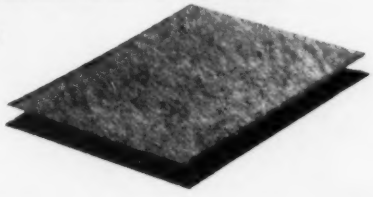


Wellington Sears ducks have the right weight and rugged, hard-gripping texture to make excellent reinforcements for C grade laminates.



Widely used in the electronic and high frequency fields, Wellington Sears spun nylon fabric insures high bonding strength and superior insulation resistance.

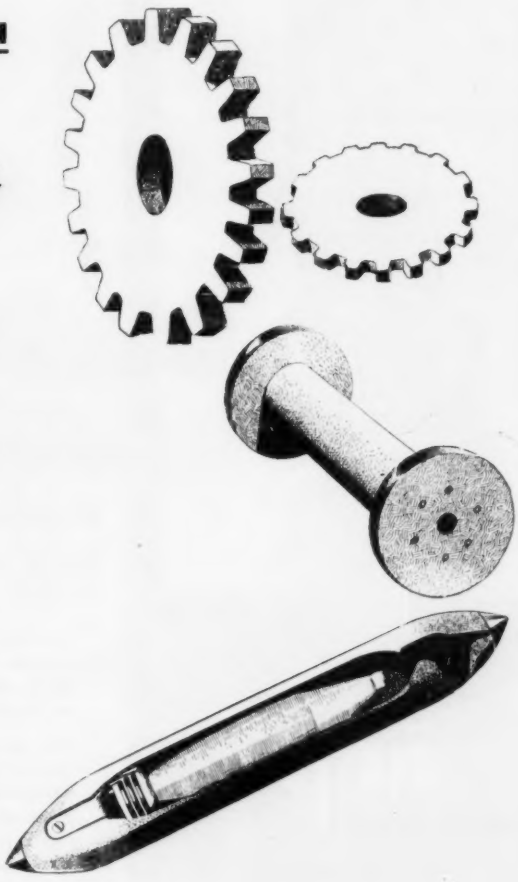
YOU GET BALANCED STRENGTH WITH WELLINGTON SEARS "LANTUCK"



Lantuck is a specially developed non-woven fabric which has achieved remarkable acceptance for laminating applications. Because of its completely random distribution of fibers, Lantuck gives laminates equal strength in all horizontal directions and exceptional machineability at high cutting speeds. It is an economical filler for fine gears, textile bobbin heads and other uses involving sharp projections or edges, mirror-like machined surfaces and superior mechanical strength.

We'd like to tell you more about Lantuck and the actual service tests conducted on end-use products. We'd like to review with you other quality Wellington Sears fabrics we have available for the plastics industry. A call or letter to our nearest sales office will do it.

Write for a free copy of "Modern Textiles For Industry" which includes pertinent information on fabric-and-plastic applications. Address: Wellington Sears, Dept. J-7, 65 Worth Street, New York 13, N. Y.



Superior Fabrics for Coating and Laminating

Single filling ducks	Broken twills
Army ducks	Drills
Single and plied-yarn chafers	Sheetings
Special ducks	Nylon, rayon and other synthetics
Sateens	Lantuck non-woven fabrics
Twills	

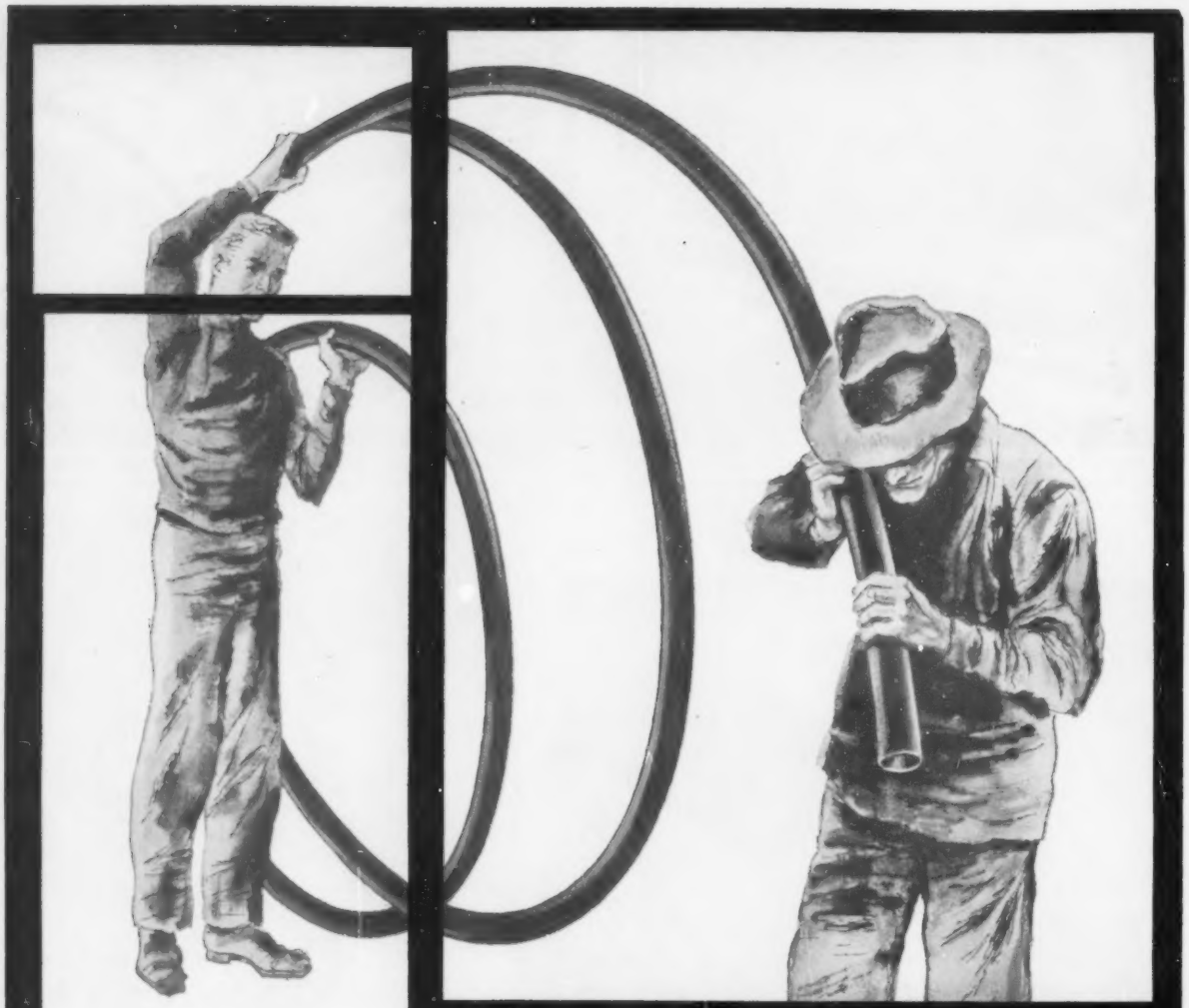
Wellington Sears

A SUBSIDIARY OF WEST POINT MANUFACTURING COMPANY

FIRST In Fabrics For Industry

WELLINGTON SEARS COMPANY, 65 WORTH STREET, NEW YORK 13, N.Y.

Offices in: Atlanta • Boston • Chicago • Detroit • Los Angeles • New Orleans • Philadelphia • San Francisco • St. Louis



Protect Polyethylene Pipe in One-pass Extrusion

with adp's new 20% black dispersion

2 to 3% concentration of thoroughly dispersed carbon black is now accepted as the most effective way of protecting polyethylene pipe from embrittlement in sunlight, and prolonging its life as much as 20 times.

Now adp offers plastic pipe manufacturers a time- and money-saving black dispersion which reduces to 3% concentration and forms the finished pipe in one pass through the extruder. The new dispersion, adp 9PE398, contains a 20% concentration of a high grade channel black, which gives the desired degree of protection with economy.

This is just one of the many important contributions adp dispersions are making to plastics coloration.

Let us tell you more about it. Write or call:

Acheson Dispersed Pigments Co.
2252 E. Ontario St., Philadelphia 34, Pa.
. . . also Acheson Colloids Ltd., Slough, England

Increased operating efficiency; lower operating costs with mixer on TIMKEN® bearings

HERE are the reasons Stewart Bolling & Company, Inc., Cleveland, uses Timken® tapered roller bearings in the split end frame housings of its intensive plastic and rubber mixers:

Timken bearings do away with extra thrust devices that cause power loss through friction. Because of their tapered design, the Timken bearings can withstand the continually changing rotor end thrust as well as the radial loads. Rotor end-play is eliminated.

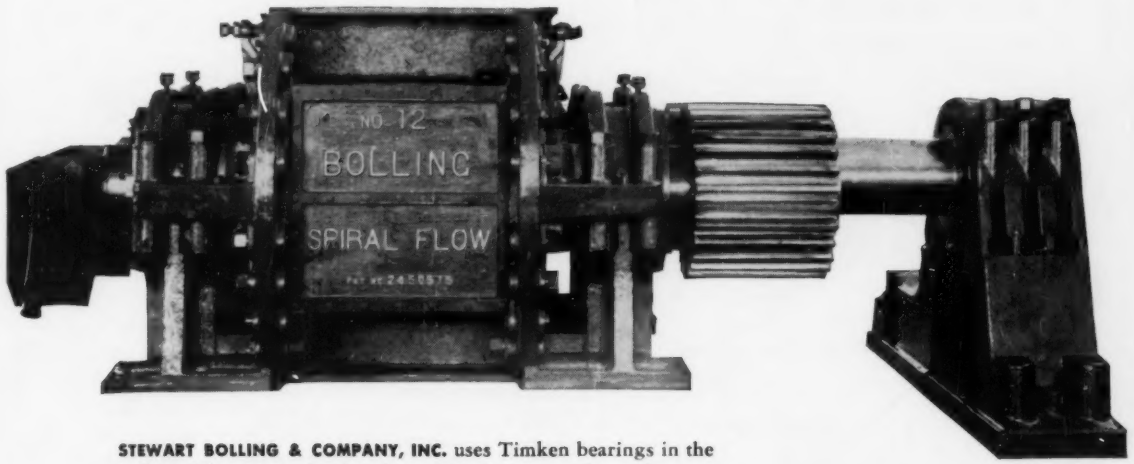
Timken bearings also maintain true centers within very minute limits, maintaining established clearances between rotors. Gears operate indefinitely on their original pitch lines, greatly reducing gear wear and replacement.

And Timken bearings, themselves, last and last because rollers and races are case-hardened to give them hard, wear-resistant surfaces over tough, shock-resistant cores.

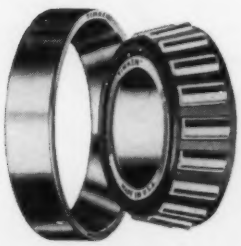
Overall result: Higher mixing speeds, improved performance, lower maintenance cost, less downtime and lower operating cost per pound.

Look for the trade-mark "Timken" stamped on every bearing to get these same advantages on your machinery. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

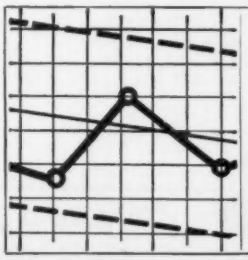
This symbol on a product means its bearings are the best.



STEWART BOLLING & COMPANY, INC. uses Timken bearings in the split-end frames on the #12 intensive mixer rotor journal to cut operating costs, assure long, trouble-free service.



TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
TAPERED ROLLER BEARINGS



STATISTICAL QUALITY CONTROL

To insure uniform high quality and closer tolerances, the Timken Company uses statistical quality control. With it, tolerance deviations are plotted graphically. It's one of industry's newest, most scientific methods of improving product uniformity.

NOT JUST A BALL ○ NOT JUST A ROLLER ⬭ THE TIMKEN TAPERED ROLLER ⬭ BEARING TAKES RADIAL ↓ AND THRUST →○← LOADS OR ANY COMBINATION →○←

HIGH QUALITY at LOW COST

for reinforced polyesters

If you're seeking ways to get better polyesters at low cost, let us recommend the right DIAMOND Precipitated Calcium Carbonate for your product.

You'll get smoother surfaces, no cracks, no evidence of glass fibers when DIAMOND Carbonates are mixed with catalyzed, glass-reinforced polyesters. And your product gets improved wet strength and reduced shrinkage.

All these at lower volume cost.

DIAMOND offers these precipitated calcium carbonates for reinforced polyesters:

Surfex® MM—coated with 1% resin; particle size about 5 microns.

Kalite®—coated with 1% stearic acid; size about one micron.

Suspenso®—same as Surfex MM, but uncoated.

Multifex® MM—uncoated; particle size about .06 micron.

Write for DIAMOND technical bulletin: *No. 8 the Application, of Precipitated Calcium Carbonates with Polyester Resins.*

DIAMOND SALES OFFICES: New York, Philadelphia, Pittsburgh, Cleveland, Cincinnati, Chicago, St. Louis, Memphis, Houston.

DISTRIBUTORS OF THESE PRODUCTS: C. L. Duncan Co., San Francisco and Los Angeles; Van Waters and Rogers, Inc., Seattle and Portland, U. S. A.; Harrisons & Crosfield (Canada) Ltd.

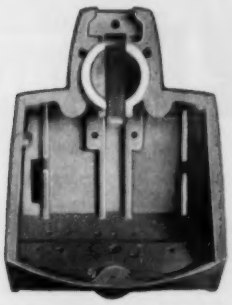
DIAMOND ALKALI CHEMICALS

DIAMOND CHEMICALS

FOR THE RUBBER AND PLASTICS INDUSTRIES

DIAMOND ALKALI COMPANY...CLEVELAND 14, OHIO

MORNINGSTAR-MOLDED
Filter.



MORNINGSTAR-MOLDED
Flash Gun Housing.

POLAROID'S *Highlander* CAMERA

Features Morningstar-Molded Plastics

Just a few years ago Polaroid Corporation made camera history with the first picture-in-a-minute Polaroid® Land Camera, named for its inventor, Edwin H. Land . . . and these 60-second masterpieces have been sweeping on to new popularity and success with each passing month. Now, the newest camera, the popular-priced Highlander, is establishing the same blazing sales pace set by the original models.

To produce the newest Polaroid camera with the superior quality demanded of all Polaroid products . . . its designers inevitably turned to modern plastics. And the need for precision, quality molding just as inevitably led to Morningstar. The parts we are now producing in quantity to meet exacting production schedules . . . with absolutely no sacrifice in quality . . . are shown above. We're proud to have been selected to mold parts for the Highlander . . . we'd be equally as proud to help solve your *precision* molding problems.

MORNINGSTAR-MOLDED
View Finder.

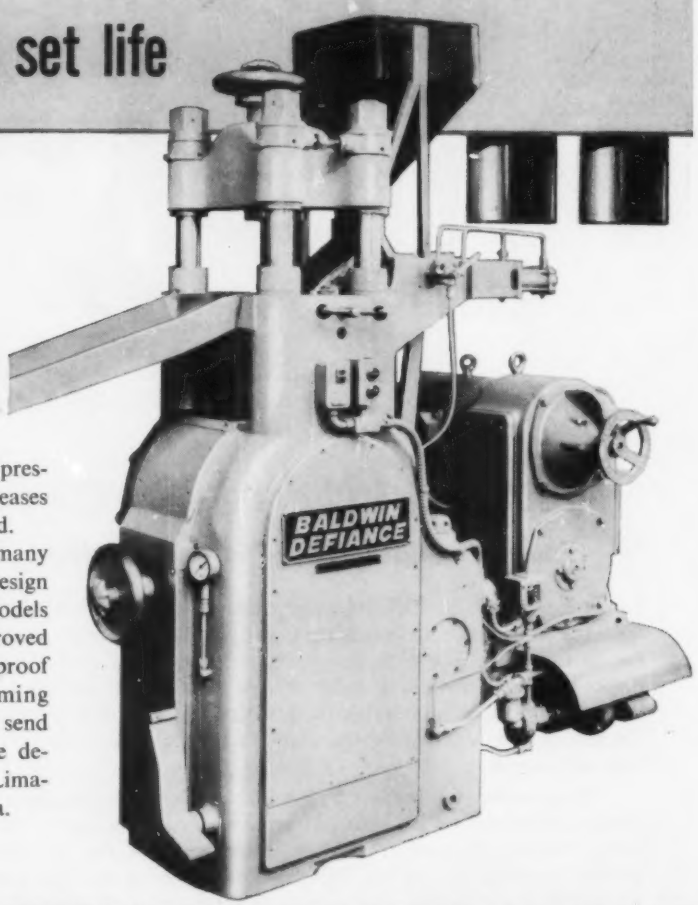
MORNINGSTAR-MOLDED
Film Spool.

The MORNINGSTAR *Corporation*
156 SIXTH ST., CAMBRIDGE 42, MASS.

Product Development
Precision Molded Products

Reduced vibration in **BALDWIN** plastics presses

increases die set life



Typical of the many outstanding features of Baldwin compacting presses is Baldwin's use of four tie rods to reduce vibration to an absolute minimum. Two connecting rods transmit pressure from the press crankshaft to these tie rods. The resulting balance of pressure practically eliminates vibration. This increases the life of the machine and of the die sets used.

Elimination of vibration is just one of many practical benefits you will get from the careful design and engineering that goes into the Baldwin Models 20 and 45. Each practical advantage has been proved in performance by user after user . . . added proof that Baldwin plastics molding and preforming presses are the finest in the industry. Why not send today for Bulletin #3103 containing complete details? Address Department 4826, Baldwin-Lima-Hamilton Corporation, Philadelphia 42, Penna.

EXCLUSIVE FEATURES OF BALDWIN PLASTICS PRESSES

- **Safeguard lubrication** reduces downtime.
- **Balanced pressure** cuts vibration for longer die set life.
- **Simple adjustments** allow weight-density changes during operation.
- **Cam controlled feeder** assures uniform tablet weights.
- **Cleanline design** prevents contamination, speeds cleaning.

BALDWIN-LIMA-HAMILTON

General Offices: Philadelphia 42, Pa. • Offices in Principal Cities

FOR "TOP DRAWER" SERVICE AND QUALITY...

SPECIFY *HEYDEN!*

SUPERFYDE®

(HEYDEN)

A solid polymer of formaldehyde characterized by an extremely low water content, high assay, low reactivity, low solubility, and high melting point. Useful in syntheses requiring formaldehyde, which are prevented or inhibited by traces of water.

CONTAINERS

Superfyde® Powder

Fiber drums, 250, 100, 50, 25 lbs.

PARAFORMALDEHYDE

(HEYDEN)

A solid source of formaldehyde, for manufacturing synthetic resins and as a catalyst for cold-setting adhesives. Also used in fungicides, deodorizers, and photographic chemicals.

CONTAINERS

Paraformaldehyde U.S.P. X

(Powder, Medium Powder, Flo-Granular)

Fiber drums, 250, 50, 25 lbs.

HEXAMETHYLENETETRAMINE

(HEYDEN)

Valuable to the synthetic resins industry in the curing of resins. Used as a chemical intermediate and as a hardening agent for casein, glue and other proteins; as a rubber accelerator; for explosives; for fuel tablets; in medicinals. As an amine, it finds use as a neutralizing or deactivating agent.

CONTAINERS

Hexamethylenetetramine Technical

Granular . . Multiwall paper bags, 75 lbs.; Fiber drums, 100 lbs.

Powder . . Multiwall paper bags, 50 lbs,; Fiber drums, 100 lbs.

Hexamethylenetetramine U.S.P.

(Methenamine U.S.P. Powder or Granular)

Fiber Drums, 100, 50 and 25 lbs.

FORMALDEHYDE

(HEYDEN)

Widely used in the production of phenolic, urea, melamine and resorcinol resins; for converting casein, glue and other proteins into plastic products. Increasingly important in manufacture of chemicals and fertilizers. Used in embalming fluids, disinfectants, fumigants, deodorants, and in the leather, fur, paper and textile industries.

CONTAINERS

Formaldehyde Solution N.F.

Tank car . . . . . 72,000 lbs.

Tank truck . . . . . 30,000 lbs.

Drums . . . . . 475; 125; 90 lbs.

Carboys . . . . . 100 lbs.

37% Formaldehyde—Methanol Free

Tank cars . . . . 72,000 lbs.

Tank trucks . . . 30,000 lbs.

FINE HEYDEN CHEMICALS

HEYDEN CHEMICAL CORPORATION

342 Madison Avenue, New York 17, N.Y.

CHICAGO · CINCINNATI · DETROIT · PHILADELPHIA · PROVIDENCE · SAN FRANCISCO

Com-plēte´ { Having no deficiency; entire; accomplished.

Amos does your complete job...RIGHT

Amos is famous for *quality* plastics . . . in *quantity.*

Amos facilities are complete . . . product design . . . engineering . . . mold building . . . molding with 4 to 300 ounce machine capacity . . . conveyorized assembly and finishing . . . vacuum plating . . . silk screening . . . hot stamping . . . roller coating . . . printing . . . spray painting—*everything* your product needs in plastics—under one roof —no divided responsibility.

Amos is privileged to serve some of the *best-known* names in American industry. Amos invites YOU to join this ever-growing list of satisfied customers—*now. No obligation . . . write, wire or phone your inquiry to:*

AMOS MOLDED PLASTICS · EDINBURG, INDIANA

Offices: Chicago, Detroit, Philadelphia. Kansas City, Mo., Nashua, N. H.

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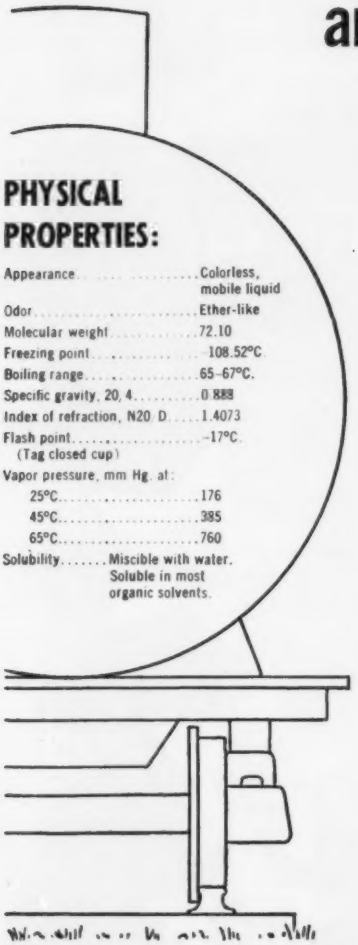
Custom Injection
Molding and Finishing Specialists

all under ONE roof...
no divided responsibility

NOW AVAILABLE IN TANK-CAR QUANTITIES...

Du Pont Tetrahydrofuran

—powerful solvent for polyvinyl chlorides and other vinyl resins



PHYSICAL PROPERTIES:

Appearance	Colorless, mobile liquid
Odor	Ether-like
Molecular weight	72.10
Freezing point	108.52°C.
Boiling range	65–67°C.
Specific gravity, 20, 4	0.888
Index of refraction, N20 D	1.4073
Flash point (Tag closed cup)	–17°C.
Vapor pressure, mm Hg. at:	
25°C.	176
45°C.	385
65°C.	760
Solubility	Miscible with water. Soluble in most organic solvents.

USE ITS HIGH SOLVENT POWER TO FORMULATE:

- Fabric coatings
- Plastic sheet coatings
- Transparent films
- Adhesives
- Printing inks
- Lacquers

With tetrahydrofuran, it's easy to dissolve stubborn plastics, resins, and rubbers. This powerful solvent dissolves high molecular weight polyvinyl chlorides and vinylidene chloride copolymers at room temperature—gives solutions with high solids content at working viscosities.

THF may also be useful as a solvent in the formulation of lacquers, adhesives, and printing ink compositions. It is also suggested for use in the production of clear, light-colored coating compositions for fabrics and plastic sheets.

EXCELLENT ADHESIVES for sealing polyvinylidene chloride sheets and bags can be made from a 10% solution of vinylidene chloride copolymer in tetrahydrofuran. Polyvinyl chloride sheets can be combined with an effective adhesive made from a 10% solution of polyvinyl chloride in tetrahydrofuran.

TETRAHYDROFURAN-WATER MIXTURES have, in some applications, a combined solvent power greater than either of the two components. The tetrahydrofuran/water azeotrope, containing 5% water, may be suitable for many solvent uses.

A SOLVENT ACTIVATOR, tetrahydrofuran greatly improves solvent power when mixed with less active solvents. For example, a 65:35 mixture of tetrahydrofuran and methyl ethyl ketone will dissolve polyvinyl chlorides at room temperature.

E. I. du Pont de Nemours & Co. (Inc.), Electrochemicals Dept., Wilmington 98, Delaware.

Mail coupon for more information

DU PONT
TETRAHYDROFURAN

DU PONT
REG. U.S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

Please send me more information on tetrahydrofuran for use in the following applications:

_____
_____
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E. I. du Pont de Nemours & Co. (Inc.)
Electrochemicals Department, MP-94
Wilmington 98, Delaware

*Name*_____
*Position*_____
*Firm*_____
*Address*_____
*City*_____ *State*_____

HITCH YOUR PRODUCTION TO A NEW STAR . . .

FULLY AUTOMATIC PRODUCTION NOW IS POSSIBLE WITH THE IMPROVED LEWIS "4". New and extremely sensitive low-pressure closing controls provide absolute safety for molds and operators . . . permit "hands off" production. These new controls feature infinitely variable adjustment and allow machine to close at normal speed with very low hydraulic pressure. If no obstruction is encountered when the moving platen reaches pre-set point, final high-pressure close is effected instantly and automatically. When moving platen meets slightest resistance in closing, the machine stops immediately and activates a warning bell and light.

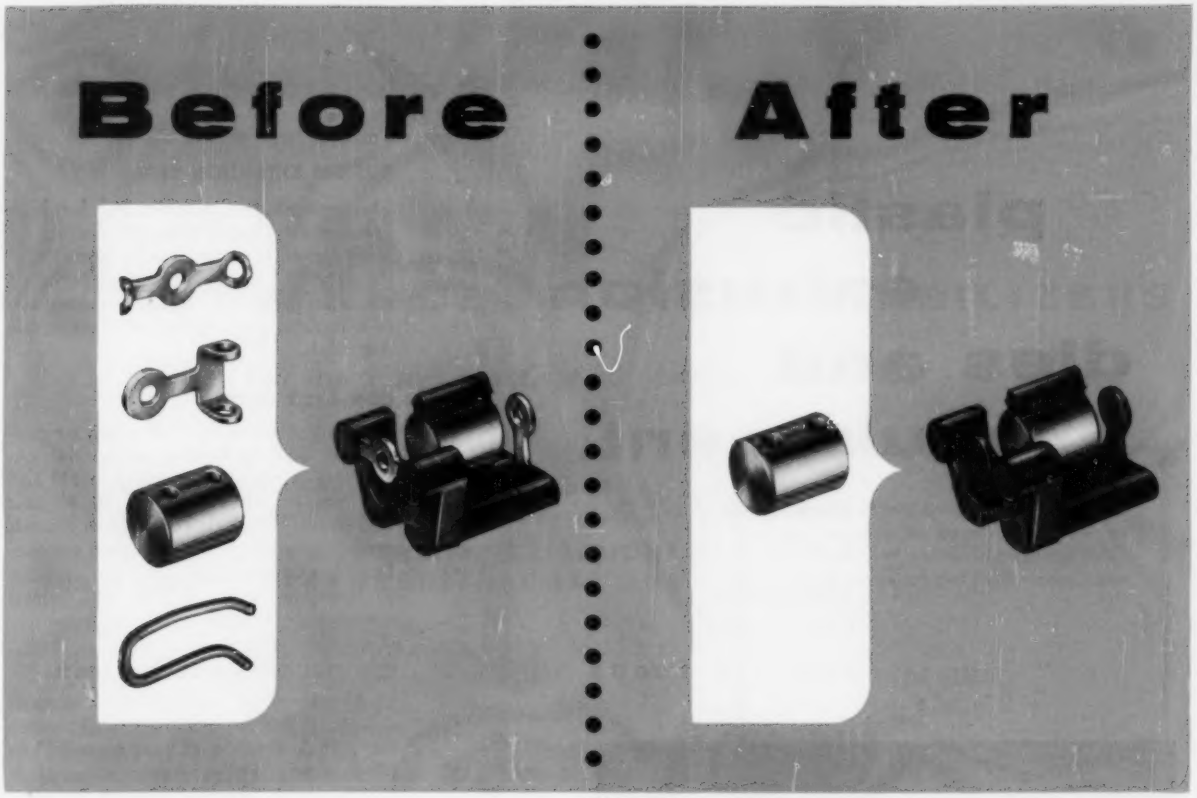
The LEWIS "4" handles almost any plastics material . . . will mold intricate 2 to 3-ounce large area parts originally produced on 8-ounce equipment. Small and sturdily constructed, Model "4" provides multiple shot injection and fast operation for high production with minimum scrap and maintenance.

Write for BULLETIN 101 for additional details.

8071-LW

THE LEWIS "4" INJECTION MOLDING MACHINE

LEWIS THE LEWIS WELDING & ENGINEERING CORPORATION
11 INTERSTATE STREET • BEDFORD, OHIO



ROGERS RX 525 REDUCES BRACKET COST BY 35%

THREE METAL PARTS ELIMINATED

High strength of RX 525 plus the fact that it can be drilled and tapped eliminated the need for metal mounting lugs. In the new bracket these lugs are plastic and integral parts of the molded piece. Parts cost was reduced 8 cents — from 23 cents to 15 cents per bracket.

MOLDING OPERATION SAVED

In doing away with the metal lugs, the molder also eliminated the special handling involved in loading them into the mold. Result: a 35% increase in molding production, using a 4-cavity transfer mold.

Rogers RX impact phenolics should be considered when you want strength in combination with low cost production. RX 525 is one of a series of phenolics in the medium to medium high impact range. These impact phenolics can be automatically preformed (pourability is excellent). They are easy to mold and fast curing; pellet-size is uniform; molded appearance is good to excellent; they are dustless.

Want more facts? Write Dept. P, Rogers Corporation, Rogers, Connecticut, or ask to see a technical representative.

Bracket is produced by Allen Electric & Equipment Company, Kalamazoo, Mich., for its electric meters.

ROGERS CORPORATION

ROGERS, CONNECTICUT

DUROIDS for Gaskets, Filters, Electronics
ELECTRICAL INSULATION for Motors, Transformers, Generators
PLASTICS — Molding Compounds and Laminates
SHOE MATERIALS for Counters, Midsoles, Liners

plastic extrusion dies and equipment

designed,
built,
tested—
for your
specific needs

Robbins
TOOL AND DIE COMPANY
1430 MISHAWAKA ST., ELKHART, IND.

CONSULT ROBBINS' Technical Service for help on your plastic extrusion problems. We specialize in the design and manufacture of shop-tested dies, heavy duty equipment, accessories. Robbins engineers plan and supervise construction of complete extrusion plants. Write today, no obligation.

never say die . . . say Robbins die!

CUSTOM EXTRUSION DIES:

Shop-tested dies, guaranteed for high production, built to your specific requirements . . . from monofilament to sheeting dies up to 60″ wide. Also offset pipe dies for ½″ to 6″ pipe for extrusion of butyrate, polystyrene or elastomeric materials.

CONVEYOR UNITS:

Sheeting conveyors with plain or perforated belt to handle up to 84″ extrusions. Take-off conveyors in 11′ and 20′ lengths with either 6″ or 8″ belt widths have built-in water tanks. Speeds range from 2 to 170 ft. per minute. Double conveyor take-off has Cap-Stan to increase output up to 30% when dual orifice dies are used.

PIPE PULL-OFF and COILING UNITS:

Dual rollers on pull-off units prevent slippage. Bottom rollers run in water for proper cooling of pipe from ½″ to 6″ diameter. Full extruder capacity is possible with separate controls for each set of rollers. Coiling unit designed for neat, efficient coiling of pipe from ½″ to 3″ diameter.

REFRIGERATED WATER TANK:

To maintain accurate control of pipe dimensions, the refrigerated water tank has proved highly efficient. Sizing rings and holders easily attached. Mobility and adjustable height are a few of the desirable features of this unit.

SHEET HAUL-OFF UNITS:

Complete with superfinished rolls and a variable speed transmission. Drive is through heavy-duty worm gear which provides smooth tension on the extruded sheet.

UTILITY SPOOL WINDERS:

Winders designed for any diameter spools, with a speed range from 0 to 200 ft. per minute. Adjustable tension and reversible automatic level wind are highly desirable features of the Robbins winder.

SHEET CUT-OFF AND PIPE SAWS — SHEARS — FORMING RACKS

Full particulars and specifications on request.

HEAT V LIGHT

HARSHAW VINYL STABILIZERS

for the vinyl plastic and coating industries

Important additives for processing and stabilizing clear and opaque vinyls—

CALENDERED FILMS AND SHEETS • EXTRUSIONS
PLASTISOLS • ORGANOSOLS • COATINGS

CADMIUM
2 — V — 4

Leading heat and light stabilizer for clear or opaque stock, an organic liquid complex containing no disadvantageous soapy component. Unequalled for stabilizing against effects of sunlight or outdoor aging.

BARIUM-CADMIUM
128 — V — 5

Leading combination of coprecipitated laurates for outstanding performance, where lubricating advantages are required. Generally 30% more effective than common barium-cadmium laurates.

Stabilizing Systems developed for Harshaw Customers, for special processing and finished product properties, may contain one of the following eleven stabilizers.

ZINC 9-V-1: Organic liquid complex containing no disadvantageous soapy component, used in selected formulations.
CADMIUM 22-V-1: For rigids, clear to translucent.
CADMIUM 24-V-1: Organic liquid complex for highest attainable clarity, used principally with dispersion resins.
CADMIUM 2-V-8: Selected laurate, used principally with low fusing resins.
BA-CD 12-V-5: Coprecipitated laurate.
BA-CD 12-V-31: Liquid combination, for low fusing resins.
ORGANIC 7-V-1: Epoxy assistant, modification of 7-V-2.
BARIUM 1-V-3: Dispersible stearate, to contribute lubricity with barium effects.
BARIUM 1-V-6: For asbestos filled tile.
BARIUM 1-V-7: Liquid, for modified plastisols and organosols.
CALCIUM 5-V-1: Dispersible stearate, to contribute lubricity with calcium effects.
CALCIUM 5-V-2: Low melting stearate, to reduce internal friction effects.

Best effects are attained for particular requirements by combining 2-V-4 or 128-V-5 in a stabilizing system with one or more of the following three stabilizers.

BARIUM
1-V-4

Compatible barium compound, minimum effect on viscosity. Permits processing at higher temperatures.

ORGANIC
7-V-2

Epoxy assistant, highly effective HCl-scrubbing agent, undiluted. Will extend stability for longer processing periods.

ORGANIC
8-V-1

Chelating agent, more than two times as effective as common organic phosphites. Inactivates harmful by-products to boost stability. Contributes to top clarity.

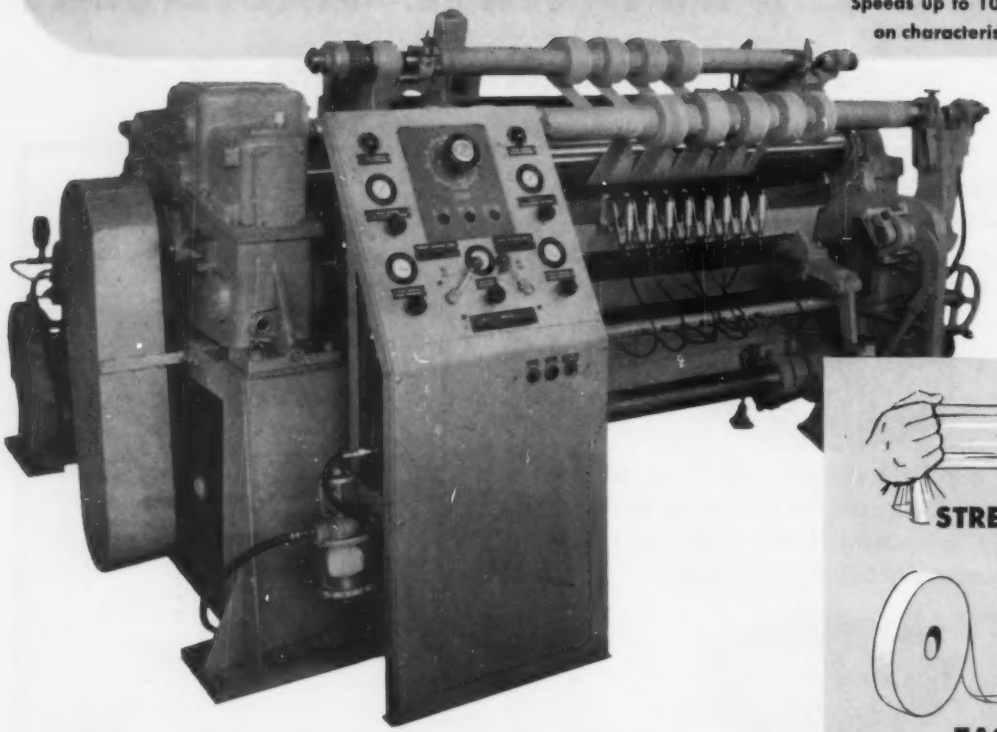
CADMIUM
28-V-2

For rigids, opaque to translucent. Stabilizes unplasticized resin efficiently and economically, with minimum effect on physical properties of product.

THE HARSHAW CHEMICAL CO.
CLEVELAND 6, OHIO

NOW...A SLITTER-REWINDER THAT CONVERTS INSTANTLY TO HANDLE any type of film, foil, paper or fabric...

Trim widths 42" to 62"
Finished rolls up to 20" dia.
Speeds up to 1000 fpm. depending on characteristics of the material.



The New CAMACHINE 500

Here's big news! The great new Camachine 500 . . . a versatile new slitter-rewinder that handles all types of plastic film, off-caliper papers, laminated paper, foils and other sensitive materials.

For the first time in one machine the Camachine 500 combines shear-cut, pneumatic score-cut and razor-type slitting. Camachine Sealcut* slitting units may also be used for heat-sealing the strip edges of fusible synthetic fabrics. You can make rapid on-the-spot changeovers to the slitting methods best suited to various materials.

A new high in efficiency! The central operating panel provides finger-tip control of starting, stopping, jogging, slitter pressure, mill roll tension, rewind shaft speed controls, rewind core friction, automatic rewind roll counterbalancing, and mill roll side shift. Built-in photo-electric side-register control provides constant automatic correction of side-wise movement of the web, reduces waste, assures clean, straight-sided finished rolls of uniform hardness.

*Registered Trade Mark

CAMERON MACHINE COMPANY • 61 POPLAR STREET • BROOKLYN 1, N. Y.

Let us make a test run on your material producing rolls to your specifications. See your Cameron representative, or write today.

DON'T WIND UP WITH LESS THAN A Camachine®

AA-291

GAIR can help

PROTECT YOUR PRODUCT

with engineered PACKAGING

Have you ever counted the hazards your product faces during transportation and warehousing? The rough handling and battering, plus pressure from stacking, are conditions that demand positive protection.

To solve the problem, Gair engineers design shipping boxes to give *two-way protection:*

1. Protection from external damage and shock – by the correct choice of box style;

2. Protection from internal shifting and breakage – by scientifically-designed inner packing.

In addition, Gair makes sure that the box is simple to pack.

Take advantage of this engineering service ... without charge. Check with the Gair factory nearest you to learn how. Learn, too, how Gair's assured material supply and delivery service can help give you the best in corrugated shipping boxes.

Ask for our booklet on the sealing of boxes.

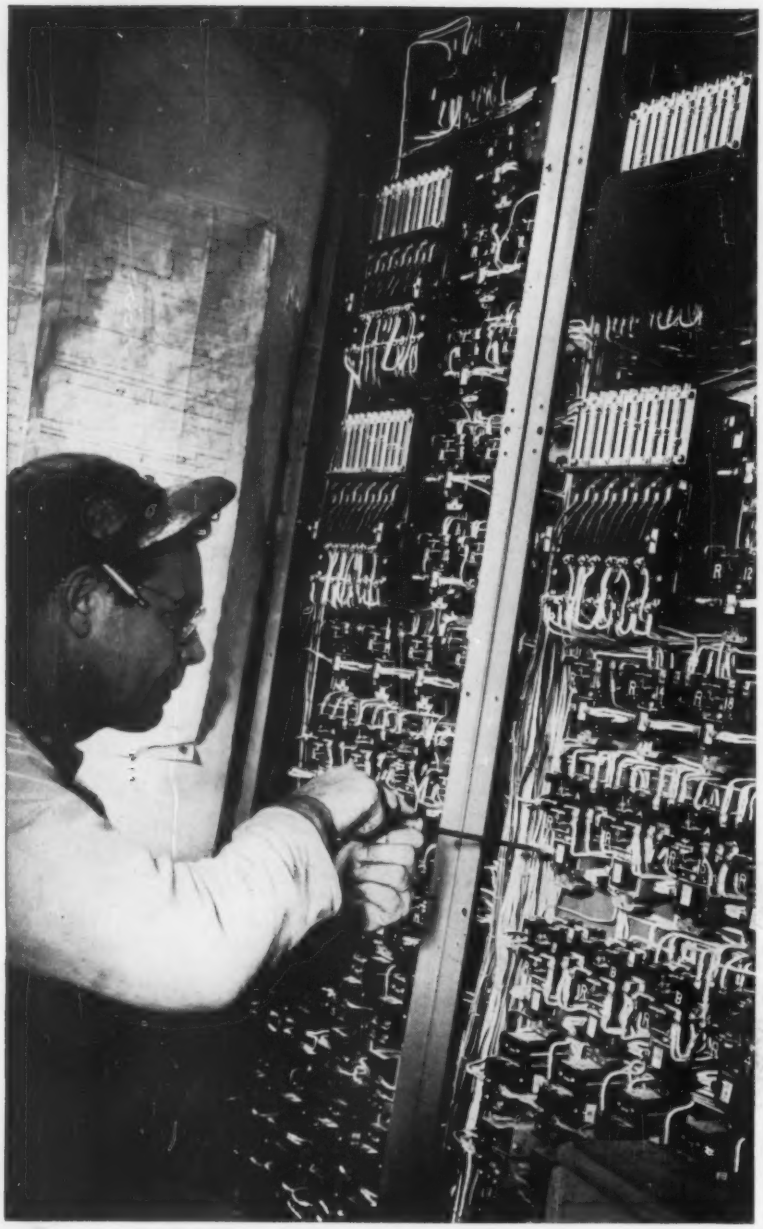
GAIR CONTAINER PLANTS:

CAMBRIDGE, MASS. • CLEVELAND, OHIO • HOLYOKE, MASS. • LOS ANGELES, CAL. • MARTINSVILLE, VA.
NO. TONAWANDA, N. Y. • PHILADELPHIA, PA. • PORTLAND, CONN. • RICHMOND, VA. • SYRACUSE, N. Y. • TETERBORO, N. J.

GAIR

SHIPPING CONTAINERS
FOLDING CARTONS
PAPERBOARD

ROBERT GAIR COMPANY, INC. • 155 EAST 44th STREET • NEW YORK 17



HERCOFLEX 150 IS MADE FOR LIVE WIRES

Complicated electrical installations, like this "switch board" which operates the centrifuge at Hercules' plant in Mansfield, Massachusetts, give longer, more dependable service when vinyl wire insulation is made with Hercoflex 150.

Hercoflex 150, one of a number of Hercules vinyl plasticizers, retains its high dielectric strength even after prolonged exposure to high temperature. And the broad range of useful temperatures observed in vinyls plasticized with Hercoflex 150 is making it increasingly popular not only for extruded wire coatings but also for cable-jacket stock.

Compatible with most primary and secondary vinyl modifiers, Hercoflex 150 can be processed quickly and economically with the various vinyl chloride polymers and copolymers. It has unusually low volatility and is always uniform in quality, properties, and performance.

Hercoflex 150 is readily available. For additional technical data, write Hercules.

HERCOFLEX® VINYL PLASTICIZERS

- **150** (di-N-octyl, decyl phthalate)
- **200** (di-iso-octyl phthalate)
- **290** (di-N-octyl, decyl adipate)

Synthetics Department

HERCULES POWDER COMPANY
INCORPORATED

916 Market Street, Wilmington 99, Delaware

SH54-2

You can simplify purchasing . . . improve design . . . speed production

with improved C-D-F DILECTO® laminates

Only C-D-F, the Continental-Diamond Fibre Company, makes Dilecto laminated plastic, just as only Cadillac makes a Cadillac. Dilecto is 50 different materials with more combinations and variations in desired properties than we can tell you here.

But Dilecto has three important qualities that you should think about if you buy, design, or machine laminated plastics.

DILECTO HAS HIGH MECHANICAL STRENGTH

Mechanical strength is frequently an important determining factor in the selection of an insulating material. Insulating parts used in large electrical power equipment are frequently bulky. The high mechanical strength of Dilecto helps reduce size-dimensions of insulating parts without danger of failure. Instruments, meters and small motors frequently require very small insulating parts which must withstand comparatively large mechanical stresses. Insulation for use in high frequency circuits should have a minimum bulk factor for minimum dielectric losses. Dilecto fulfills these requirements with a combination of high mechanical strength and low loss factor, characteristic of the better C-D-F electrical grades.

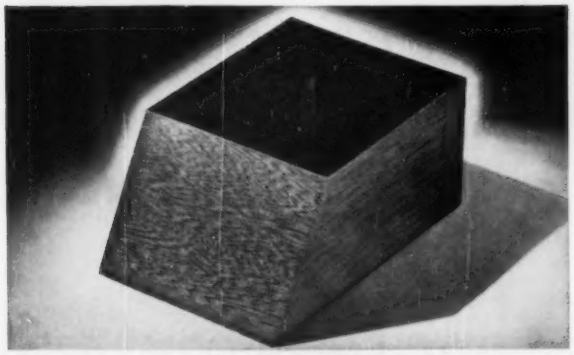
So C-D-F selects for your Dilecto insulation grade the correct, highest quality base material, paper, cotton, nylon, glass. These are used in combination with improved penetrating resins: Improved Phenolic, New Melamine, New Silicone, New Teflon, all synthetic, well polymerized resins.

Both the base and the resin are good insulators by themselves. But C-D-F sells them to you in an improved, practical form . . . Dilecto. Uniform sheets, tight tubes, strong rods, close tolerance machined and formed specialties, high bond strength metal clads.

Why does Dilecto combine so well mechanical strength with dielectric strength and dimensional stability? Because Dilecto is almost homogeneous, a true blend of resin and base.

DILECTO IS ALMOST HOMOGENEOUS

A poor laminate absorbs moisture at its edges, loses its insulating properties fast. Entrapped moisture and other volatiles within the cured structure causes inconsistent dielectric strength, with ultimate puncture and breakdown.



Punch press and bench saw operators know how much time and material is saved when the laminated plastic is *uniform* and *homogeneous* in nature like Dilecto.

DILECTO IS IMPROVED

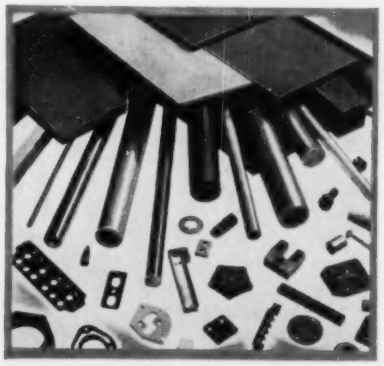
Yes, C-D-F Dilecto is an improved laminated plastic, due to high standards and advances in resin and manufacturing techniques. It is watched by skilled workers in our modern plants, checked against rigid standards . . . C-D-F standards . . . by our quality control people. It is easy to machine, and the C-D-F shops are doing a booming business in specialties.

Table I—Typical Improved Phenolic Laminates

Commercial designation[a]	Resin	Filler	Improved properties	Improvement due to:
MEC-5	Phenolic	Nylon fabric	Insulation resistance; moisture resistance	Filler
XXHV-2[b]	Phenolic	Paper	High dielectric strength parallel to laminations	Resin and manufacturing technique
CRD	Phenolic	Cotton mat	Better machining	Filler
XXXP-26[b]	Phenolic	Paper	Insulation resistance; moisture resistance	Resin and manufacturing technique
C-92	Xylenol[c]	Cotton fabric	Alkali resistance	Resin
CF	Modified phenolic	Cotton fabric	Postforming	Resin

[a] All grades are Continental-Diamond Fibre Company.
[b] Resins have improved penetrating properties and the manufacturing techniques use these properties to provide better impregnation of the filler. Since thorough impregnation eliminates entrapped moisture and air, greater moisture resistance and better dielectric properties are attained. Manufacturing techniques also provide suitable temperature control during the curing stage to assure uniform quality and optimum property values in the finished laminate.
[c] Xylenol is essentially a dimethyl phenol.

—from Electrical Manufacturing Article "Wider Design Opportunities with the NEW Phenolics", Part II.



The next time you think of laminated plastics, the name to remember is C-D-F Dilecto. The improved, high strength, uniform material that makes insulation buying and using more a science, less a puzzle. New grades, new applications, new savings are just part of the Dilecto success story. Look up the facts in Sweet's Design File, or write for catalog. Send us your blueprint for quotation . . . tell us your design dream . . . C-D-F wants to work with you.

Continental-Diamond Fibre

CONTINENTAL-DIAMOND FIBRE COMPANY
NEWARK 28, DELAWARE

MOSLO

MODERN Automatic PLASTIC INJECTION MOLDING MACHINES

Before you buy any plastic molding machine, either fully automatic or hand operated, we urge you to investigate the features of the MOSLO line. These are the machines that are setting new and higher standards of quality production for many types of molding operations. They have the effective controls, rugged construction, reliability and speed that make profitable production possible, year after year, in all lines of the plastic molding industry. Savings extend to materials and mold cost as well as productive time.

We invite your inquiry. Write for complete information, stating your requirements. We will be pleased to arrange a demonstration.

MODEL 73

- 2 oz. injection capacity per shot
- 1200 cycles per hour
- 25 lbs. per hr. *plus* plasticizing capacity
- Molds 20 square inches of area *plus*
- Material hopper capacity—40 lbs.
- Mold opening 6"

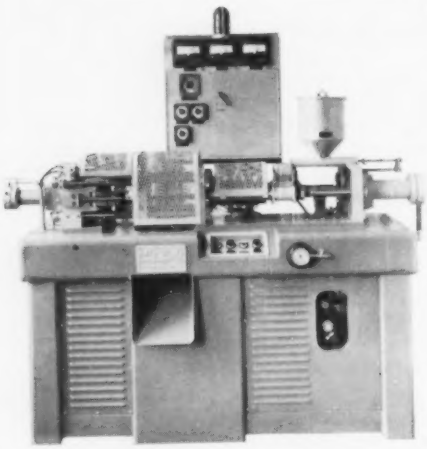
MODEL 75

- 2-3 oz. injection capacity per shot
- 740 cycles per hour
- 50 lbs. per hr. plasticizing capacity
- Molds 40 square in. of area
- 50 lbs. capacity of material hopper

This machine is available with mold arrangement and cycle to fit requirements of mold opening from 8 to 16 inches.

MODEL 80

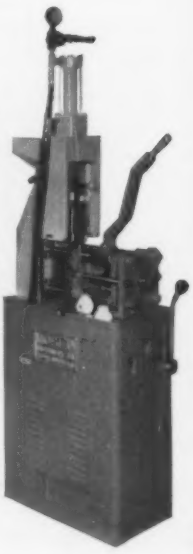
- 3-4 oz. injection capacity per shot
- 950 cycles per hour (dry run)
- 75 lbs. per hr. plasticizing capacity
- Molds 60 sq. inches of area
- 60 lbs. capacity of material hopper
- Mold opening 8"



MODELS 73 - 75 - 80

MODEL HC 75
HYDRAULIC MINIJECTOR

- ¾ oz. injection capacity per shot
- Mold size 6"x5"x 5⅛"
- 5.5 lbs. per hr. plasticizing capacity
- Molds 6 sq. in. of area
- 4 lbs. capacity of material hopper
- Vickers hydraulic pump equipment
- Ideal for small parts and die tryout

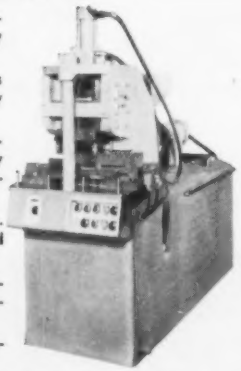


¾ OUNCE HAND OPERATED MINIJECTOR

- Ideal for schools, laboratories, die tryout and for making small parts
- ¾ oz. injection capacity per shot
- Mold size 6½"x2"x 2⅝"
- 4 lbs. capacity of material hopper
- Thermostatic control up to operating temperature 100° to 600°
- Available either as a bench model or floor model

DUPLIMATIC MINIJECTOR

- 2½ oz. injection capacity per shot
- 450 cycles per hour (dry run)
- 35 lbs. plasticizing capacity of material cylinder
- 20 sq. in. maximum mold casting area
- 25 lbs. capacity of material hopper
- Mold opening 2½"



This is the machine that has become standard in electrical industry for insert work. Especially suited for high speed production of molded cord plugs, switch parts, etc.

MOSLO MACHINERY COMPANY

2443 Prospect Avenue Cleveland 15, Ohio

9055 DGP...for low cost

there is a

PLASTOLEIN® PLASTICIZER

which fits <u>your</u> specific needs

If you need low temperature performance...
Plastolein 9058 DOZ (di-2-ethylhexyl azelate) and 9057 DIOZ (di-iso-octyl azelate), the most versatile *low-temperature* vinyl plasticizers available, are characterized by outstanding low-temperature flex, low volatility, high plasticizing efficiency, good heat and light stability and unusually low water and soapy water extraction.

If you need extreme permanence...
Plastolein 9720 imparts extreme *durability* and *weatherability* to plastic materials—providing unusually low volatility, high resistance to oil and water extraction, excellent stability to heat and light, resistance to migration.

If you need low-cost...
Plastolein 9055 DGP is a low cost, *low-temperature, secondary* plasticizer which provides high efficiency, good all-around performance and excellent chemical stability.

Investigate the advantages of the Plastolein Plasticizer that best fit your purposes. Write Dept. F9 today for *new* descriptive booklet or evaluation samples.

Emery

Fatty Acids & Derivatives
Plastolein Plasticizers
Twitchell Oils, Emulsifiers

Emery Industries, Inc., Carew Tower Cincinnati 2, Ohio

New York • Philadelphia • Lowell, Mass. • Chicago
San Francisco • Cleveland

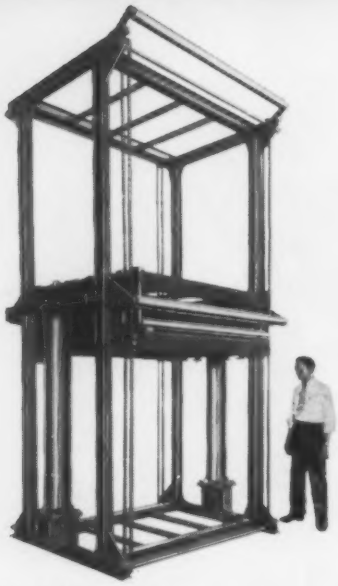
Warehouse stocks also in St. Louis, Buffalo, Baltimore and Los Angeles

Export: 5035 RCA Bldg., New York 20, New York

ADAMSON UNITED

Rubber..... AND Plastics

CALENDER ACCESSORY EQUIPMENT



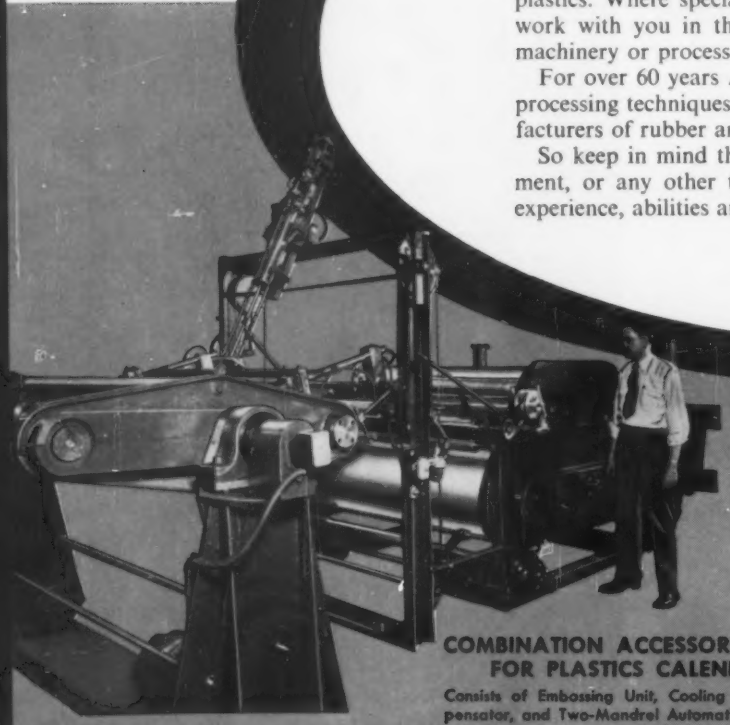
FESTOONER

A double-acting unit for handling various types of tire cord. It is used in conjunction with high-speed precision calendering equipment to store fabric while the let-offs or windups are stopped for roll changes.

Adamson not only engineers and builds a complete line of standard and special calenders, but in addition can supply all types of Calendering Accessory Equipment required for the continuous processing of rubber or plastics. Where special equipment is needed, our engineers are available to work with you in the development, design and construction of the right machinery or process to meet your requirement.

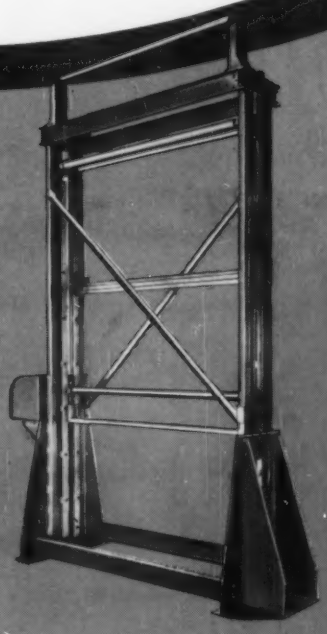
For over 60 years Adamson has pioneered in the advancement of rubber processing techniques, and today is a major supplier of equipment to manufacturers of rubber and plastics products the world over.

So keep in mind that whether it's Calenders, Calender Accessory Equipment, or any other type of rubber or plastics processing machinery, our experience, abilities and manufacturing facilities are at your service.



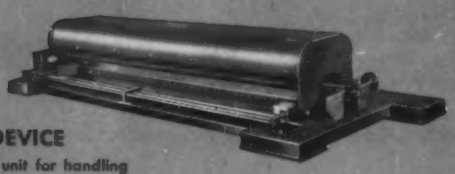
COMBINATION ACCESSORY TRAIN FOR PLASTICS CALENDER

Consists of Embossing Unit, Cooling Drum Stand, Compensator, and Two-Mandrel Automatic Turret Windup.



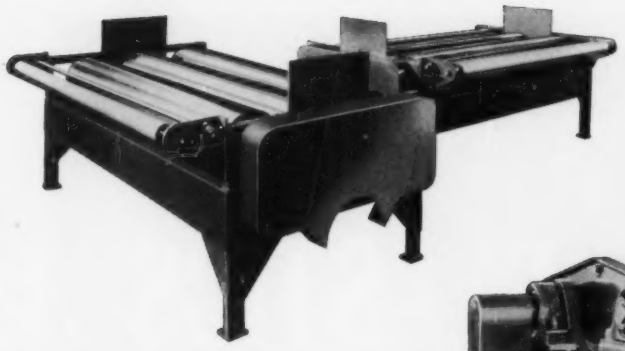
SINGLE ROLL COMPENSATOR STAND

For coordinating the speed of various elements in a calender train.



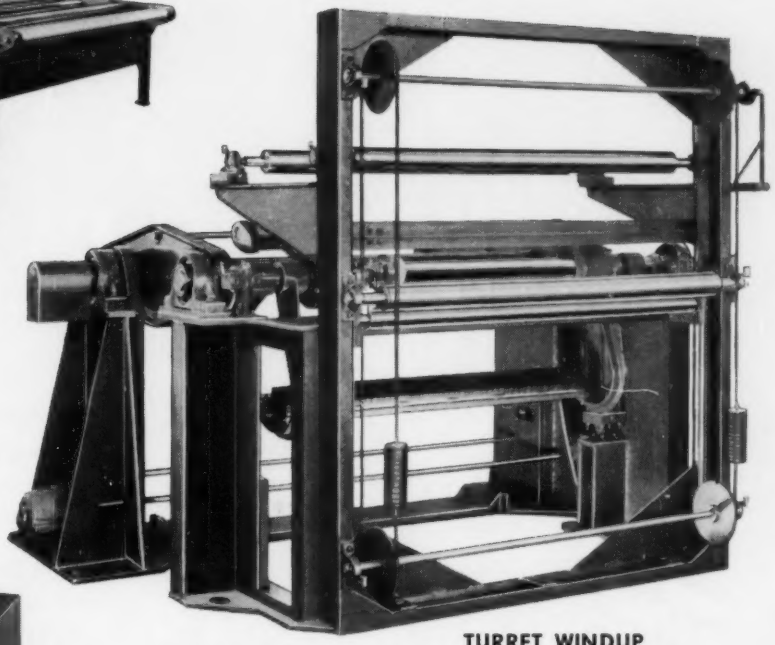
FABRIC CENTERING DEVICE

A rugged, 3-roll motor-driven unit for handling tire cord prior to its entry into the calender.



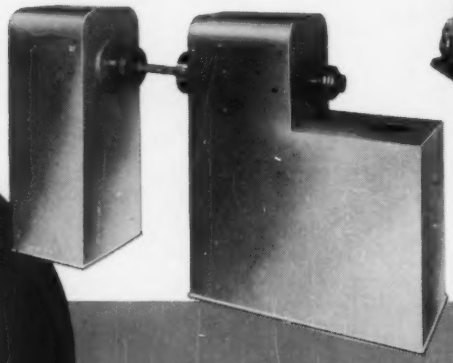
SURFACE WINDUP UNITS

Simple, conventional, drum-type windups for handling plastic film, plastic sheeting and coated fabrics.



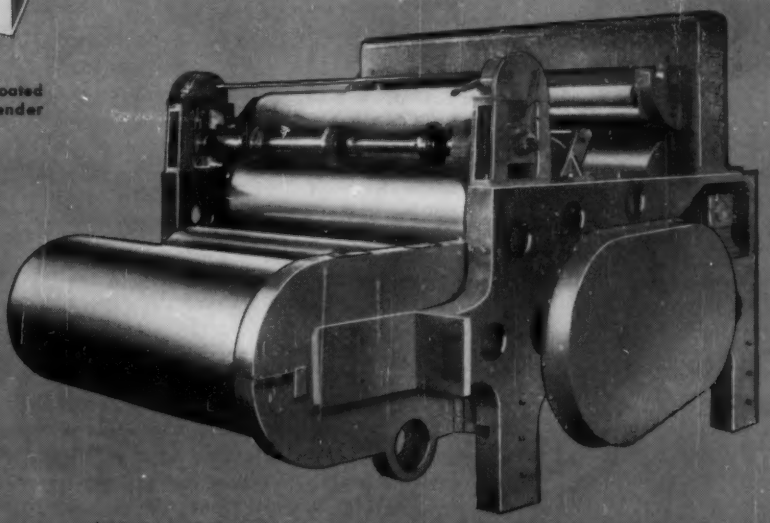
TURRET WINDUP

A special, center-drive windup designed specifically to wind very thin plastic film under accurately controlled, minimum tension. Equipment includes Two-Mandrel Turret, Automatic Counter and Cutting Device.



SIMPLE WINDUP STAND

Motor driven type for winding of coated fabric. Floor mounted type. Calender mounted units are also available.



FABRIC and LINER LET-OFF

Friction type, used in handling fabric for 3-roll universal calenders or for 4-roll double-coating calenders.

SPECIAL COMBINATION COOLING AND CUTTING DEVICE for RIGID PLASTIC SHEETING. Used with 4-roll calenders, with gear ratio changing equipment, to modify length of cut. Trim chopping device included.

Write, wire or 'phone us today; without obligation, of course.

ADAMSON UNITED COMPANY

730 CARROLL STREET • AKRON 4, OHIO

SALES OFFICES IN PRINCIPAL CITIES

Subsidiary of United Engineering and Foundry Company

Plants at: Pittsburgh • Vandergrift • New Castle • Youngstown • Canton

Presenting

Now—A FIRE-RESISTANT Polyester opens a new market for you

Whenever you've thought about new customers for your polyester glass fiber fabrications, you probably have considered interior building applications.

Now, if you make polyester sheet, you can start thinking and *planning* for a building boom—with only your imagination to limit the future.

How can you use HETRON?

How would you *like* to use it?

See how HETRON's characteristics match up to your structural ideas:

Fire Resistance—Sheets and shapes made with HETRON are self extinguishing. They will not support a flame because HETRON has a high chemically bound chlorine content. "Tunnel" tests give it a flame spread rating of less than 100. And as little as 1% antimony trioxide will give even lower flame spread.

Heat Resistance—In test after test, HETRON-based materials have proved their ability to resist heat degradation.

Better Fabrication—You'll find HETRON gives excellent results in molding curved and irregular shapes. That's because of low shrinkage and good flow characteristics.

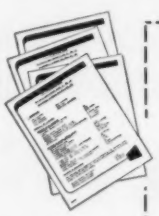
Plus Properties—Sheets and shapes made with HETRON won't rust . . . won't corrode . . . and won't rot.

You can now obtain HETRON polyesters in commercial quantities. They are light colored, transparent, viscous liquids. Hooker laboratories will cooperate fully with you in investigation of building applications or any other "use" ideas.

TYPICAL PROPERTIES

- Weight loss of castings:
  - After 168 hrs. at 392°F 2-3%
  - After 720 hrs. at 392°F 5-15%
- Flexural strength retention of glass cloth laminates (tested at room temperature)
  - After 168 hrs. at 392°F ..... up to 90%
  - After 720 hrs. water immersion ... 92%
- Shrinkage during curing 5%
- ASTM heat distortion point of castings ..... up to 285°F
- Electrical properties of castings at 10^9 cycles:
  - Dielectric constant 2.85
  - Power factor ..... .00575
  - Loss factor ..... .0164

FOR COMPLETE INFORMATION on HETRON resins, mail the coupon today. You'll receive technical data sheets listing properties of the liquid resins, cured unfilled resins, and glass cloth laminates. Includes general handling and curing recommendations, and other useful information.



HOOKER ELECTROCHEMICAL COMPANY,
18 Forty-seventh Street, Niagara Falls, N. Y.

Gentlemen: Please send me more information on HETRON resins.

Name ..... Title .....

Company ..... Address .....

City ..... Zone ..... State .....

HOOKER CHEMICALS

From the Salt of the Earth

4-626

HOOKER ELECTROCHEMICAL COMPANY

NIAGARA FALLS • TACOMA • MONTAGUE, MICH. • NEW YORK • CHICAGO • LOS ANGELES

Geared

CYCOLAC®

THE *New* HIGH-IMPACT THERMOPLASTIC RESIN

for ALL-AROUND ECONOMY in production . . .

Cycolac is a single uniform resin which is permanently thermoplastic, permitting fast molding, calendering and extruding, and reuse of trim and cutting scrap. Also economical to form from press-polished sheets by vacuum, air-pressure, or mechanical methods over inexpensive molds of wood, plaster, aluminum, etc.

Some of the 1,001 End Products Made with CYCOLAC

- Chemical & Industrial Piping
- Molded Pipe & Industrial Fittings
- Signs - Display Racks
- Kitchen Accessories
- Appliance & Tool Handles
- Rain Gutters
- Bottle Closures
- Desk Tops
- Profile Extrusions

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Marbon

MARBON CORP.

GARY, INDIANA

SUBSIDIARY OF BORG-WARNER

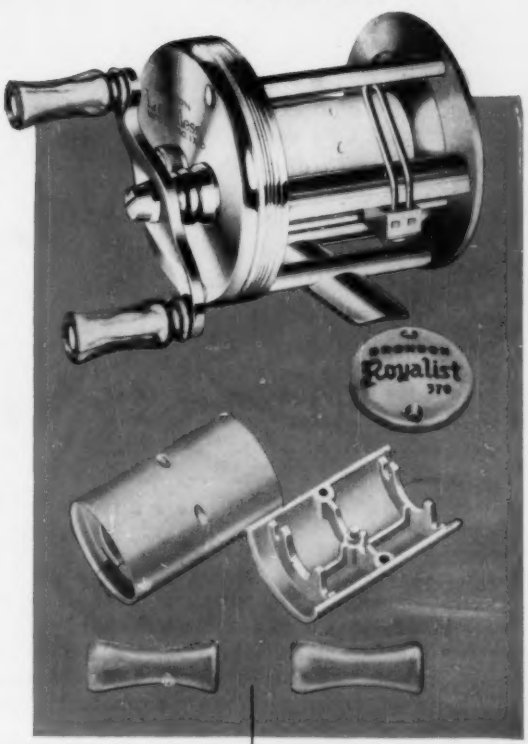
MARBON . . . *Precision Resins for Precision Made Products*

"A Sure Catch for REEL ANGLERS"

custom molded and finished in

TRADE ERIE MARK

Three Dimensional Plastics



This intriguing three dimensional plaque is sure to catch the angler's eye on the counter or in the window of any sporting goods dealer who displays it . . . and its rare beauty is assurance that it will have a prominent place. The plaque is 4" by 8", with a ruby-red background that catches every ray of light. The reel and lettering are in shining silver, and all is permanently protected for a long sales life.

ERIE Three Dimensional Plastics are the richest thing you can buy, for signs, name plates, or trademarks. We can show you an amazing assortment of samples, produced for America's leading manufacturers in many lines.

ERIE CUSTOM MOLDED PLASTIC PRODUCTS for . . .

- Automotive Industry
- Radio and TV Industry
- Electrical Appliance Industry
- Amusement Industry
- Photographic Industry
- Dentist's and Doctor's Equipment
- Three Dimensional Name Plates
- National Defense

Write for your copy of bulletin, "Who We Are . . . What We Do in Plastics."

TRADE ERIE MARK RESISTOR CORP.

ERIE RESISTOR CORPORATION . . . PLASTICS DIVISION

Main Offices and Factories: **ERIE, PA.**

Sales Offices: Cliffside, N. J. • Philadelphia, Pa. • Chicago, Ill. • Detroit, Mich. Ashland, Ohio • Fort Wayne, Ind. • Los Angeles, Calif. • Toronto, Ontario

Manufacturing Subsidiaries:

HOLLY SPRINGS, MISS. • LONDON, ENGLAND • TRENTON, ONTARIO

ERIE also molds the snap-on two-piece precision fitting arbors, handle grips and name buttons for several models of Bronson Reels.

Photographed at Wiggins Plastic Molding Company, Belleville, N. J.

same press...same time...25% more production

Now four molding presses do the work of five where Borden's GP-102 phenolic molding compound is used. GP-102 cures 25% faster, producing more parts in less time at less cost.

Versatile GP-102 is adaptable to a wide variety of parts . . . from electric switch plates and fishing reels to radio cabinets. In black or brown, it produces a high surface lustre and high strength. GP-102 is designed for all thermosetting equipment —plunger, transfer and compression.

Why not try a sample run in your plant. A Borden Technical Representative will be glad to arrange a demonstration of GP-102's time-saving and cost-cutting properties. Call today or mail coupon to The Borden Company, Chemical Division, Durite Products, Department MP-94, 5000 Summerdale Avenue, Philadelphia 24, Pennsylvania.

Phenolic Molding Compounds • Abrasive and Frictional Bonding Resins
Molding and Specialty Resins • Lamp Basing Cements

MP-94

The Borden Company, Chemical Division
DURITE Products Department
5000 Summerdale Avenue, Philadelphia 24, Pa.

Please send sample and technical description of DURITE GP-102. Please have your technical representative arrange a demonstration of GP-102 in my plant.

NAME_____ TITLE_____

COMPANY_____

ADDRESS_____

CITY_____ ZONE____ STATE_____

DURITE

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THE *Borden* COMPANY

CHEMICAL DIVISION

DEEGLAS

GLASS FIBRE MAT

for better mouldings

Just as metal tie-rods increase the strength of concrete, so Deeglas Glass Fibre Mat makes possible stronger plastic mouldings. Deeglas reinforced plastic is being used in increasing quantity by the Services and Industry, particularly for aircraft parts, boat hulls and car bodies. Deeglas offers the following advantages. It is easy to handle and simple to mould. It has an even distribution of fibre, and does not vary in density across width or length. Deeglas can now be supplied pre-impregnated with a range of resins.

Deeglas PUTS **STRENGTH** INTO PLASTICS

For further details and samples of Rovings, Chopped Fibre and Cloth write to:

GLASS YARNS & DEESIDE FABRICS LTD.

Craven House, 121 Kingsway, London, W.C.2, England.

GD.3

...another **KENT** service!

Long recognized as a leader in the field of three-dimensional decorative plastics, Kent now offers the cost-saving advantages of Vacuum Forming.

Using the most modern equipment obtainable, Kent is vacuum forming quality parts in all sizes up to 78" x 40" from a variety of thermoplastic sheet materials.

Savings of up to 90% on production molds are just one of the many advantages of Kent Vacuum Forming. Tooling is fast and low in cost . . . enabling the manufacturer to get into production quicker.

Special techniques developed by Kent Plastics engineers utilize thinner wall sections where desirable, with amazingly deep draws.

Vacuum forming by Kent is adaptable to many industries. Typical uses are for packaging, containers, trays, TV masks, radio cabinets, refrigerator inner door panels, displays, signs, etc.

If you would like to learn how Kent Vacuum Forming can be adapted to your product, mail the coupon below.

KENT PLASTICS
CORPORATION

EVANSVILLE 10, INDIANA

KENT PLASTICS CORPORATION
1500 N. Fulton Avenue
Evansville, Indiana

Have a representative contact us concerning Vacuum Forming

NAME.....

TITLE.....

COMPANY.....

ADDRESS.....

CITY.....STATE.....

5-ton mold of CRUCIBLE CSM 2 produces butyrate hobby horse

Five tons of Crucible CSM 2 mold steel went into this two-cavity mold built by the Enduro Tool and Engraving Company, for Wonder Products, manufacturers of a new plastic hobby horse. Body of the horse, injection molded by Ger-Ell Manufacturing Company, is made of 5½ pounds of medium-flow ivory butyrate, in a mold measuring 40 x 18 x 55 inches, and weighing over 10,000 pounds.

It's with good reason that Crucible mold steels are specified for the big jobs. Made by the electric furnace process in the country's largest tool steel mill, Crucible mold steels actually *are* tool steels. And because they are tool steels you can be sure of uniformly high quality from piece to piece.

So, no matter how large or small your next job may be — call Crucible for your mold steel needs.

CRUCIBLE first name in special purpose steels

54 years of Fine steelmaking **MOLD STEELS**

CRUCIBLE STEEL COMPANY OF AMERICA • TOOL STEEL SALES • SYRACUSE, N. Y.

REX HIGH SPEED • TOOL • REZISTAL STAINLESS • MAX-EL • ALLOY • SPECIAL PURPOSE STEELS

THIS PLASTISOL EXPANDS UNDER HEAT AT ATMOSPHERIC PRESSURE TO FORM A VINYL SPONGE

Sponge Plastisol is a recent development in the versatile family of flexible plastisol products.

Spraying:

Sponge Plastisol may be sprayed to flat, vertical or curved surfaces. Varied uses as sound deadening or insulation against heat or cold on refrigerators, air-conditioning units, automotive bodies may be obtained.

Spreading:

Spread coating on textile or paper stock, etc. may be accomplished with Sponge Plastisol.

Molding:

Sponge Plastisol may be poured into molds to form arm rests, crash pads, gaskets, squeeze balls, etc.

Dip Coating:

Dipping of wire baskets, etc. to insulate against shock is a typical application of Sponge Plastisol.

The Watson-Standard laboratories have formulated compounds for many end uses and methods of application. We will assist you with your problems.

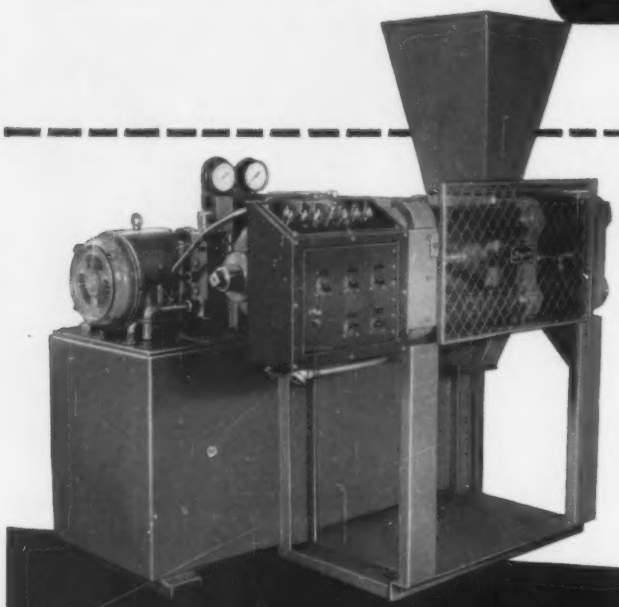
Watson-Standard CO.

225 GALVESTON AVE., PITTSBURGH 30, PA.

NEW YORK OFFICE: 15 Park Row, New York 38, N. Y. • CHICAGO OFFICE: 55 E. Washington St., Chicago 2, Ill.

PLASTICS · INDUSTRIAL FINISHES · CHEMICALS

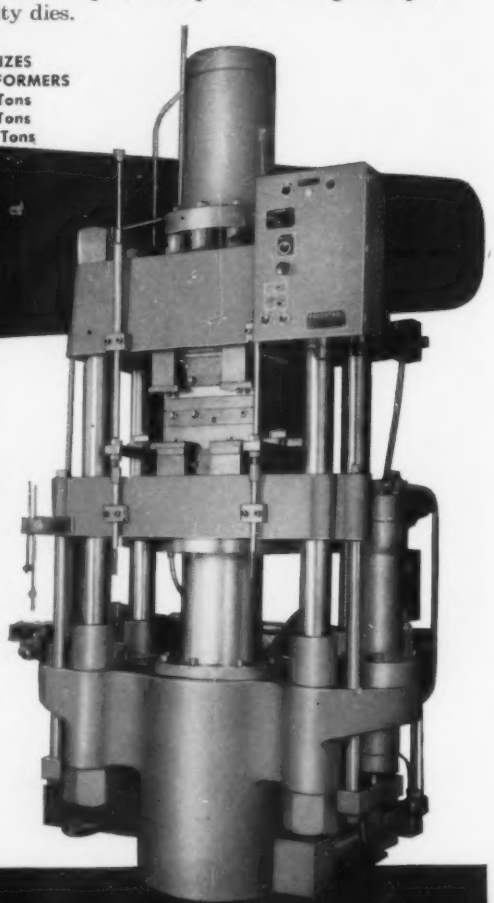
FOR HYDRAULIC PRESSES OR PREFORMERS CALL



NEW ALL HYDRAULIC Preformer

Horizontal design permits gravity discharge, minimizing breakage and damage to preforms. It also makes possible automatic preforming of impact type materials rapidly and accurately. Operation is practically dust free. Rods and guides are fully enclosed. Makes up to 25 sq. in. per shot or up to 7200 per hour using multiple cavity dies.

3 SIZES OF PREFORMERS
45 Tons
85 Tons
125 Tons



CUSTOM ENGINEERED HYDRAULIC Presses

Fast low cost production follows the selection of a Logan Hydraulic Press. In the new line of Logan Presses are a wide choice of self-contained hydraulic, fast traverse governed pressures with up or down stroke, top or bottom transfer and with semi-automatic precise controls as well as other features that will shrink your production costs. Complete range is from 10 to 300 tons.

Write for complete data on Logan equipment before you buy.

MADE IN FOUR POST DESIGNS, "C" FRAME STYLES, SPECIAL APPLICATIONS

No. 1 IN A SERIES—TAKING THE MYSTERY OUT OF POLYESTER RESINS

This Wide Range of Properties Available in Glykon* Pre-Blended Resins

...AT SUBSTANTIAL SAVINGS!

PHYSICAL PROPERTIES OF UNFILLED CASTINGS CONTAINING VARIOUS BLENDS OF GLYKON RIGID AND FLEXIBLE RESINS

Following Glykon R F designations represent percentages of rigid and flexible resins in each blend.	Glykon R-100	RF 90/10	RF 80/20	RF 70/30
Flexural Strength—psi	17,220	15,350	13,100	11,310
Modulus of Elasticity—psi	534,000	375,000	369,000	250,000
Tensile Strength—psi	7,665	7,450	7210	7140
Barcol Hardness	48	45	40	33

There is no need to keep you guessing about the blend proportions of the resins you buy. The Glykon blending table above shows these important ratios with resulting physical properties. In these pre-blended resins you get high reactivity, good wetting properties and light stability—at a standard price.

General will pre-blend any of the resins listed in quantities starting at 20,000 pounds. You are saved the time, trouble and higher cost involved in buying and mixing resins yourself. With blends of rigid Glykon R-100 and flexible Glykon F-600 you can meet practically the whole range of fabricating requirements.

For more information fill out the coupon below or write to The General Tire & Rubber Company, Chemical Division, 1708 Englewood Avenue, Akron 9, Ohio.

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Chemical Division
GENERAL
THE GENERAL TIRE & RUBBER CO.
GLYKON

The General Tire & Rubber Company • Chemical Division
1708 Englewood Avenue, Akron 9, Ohio

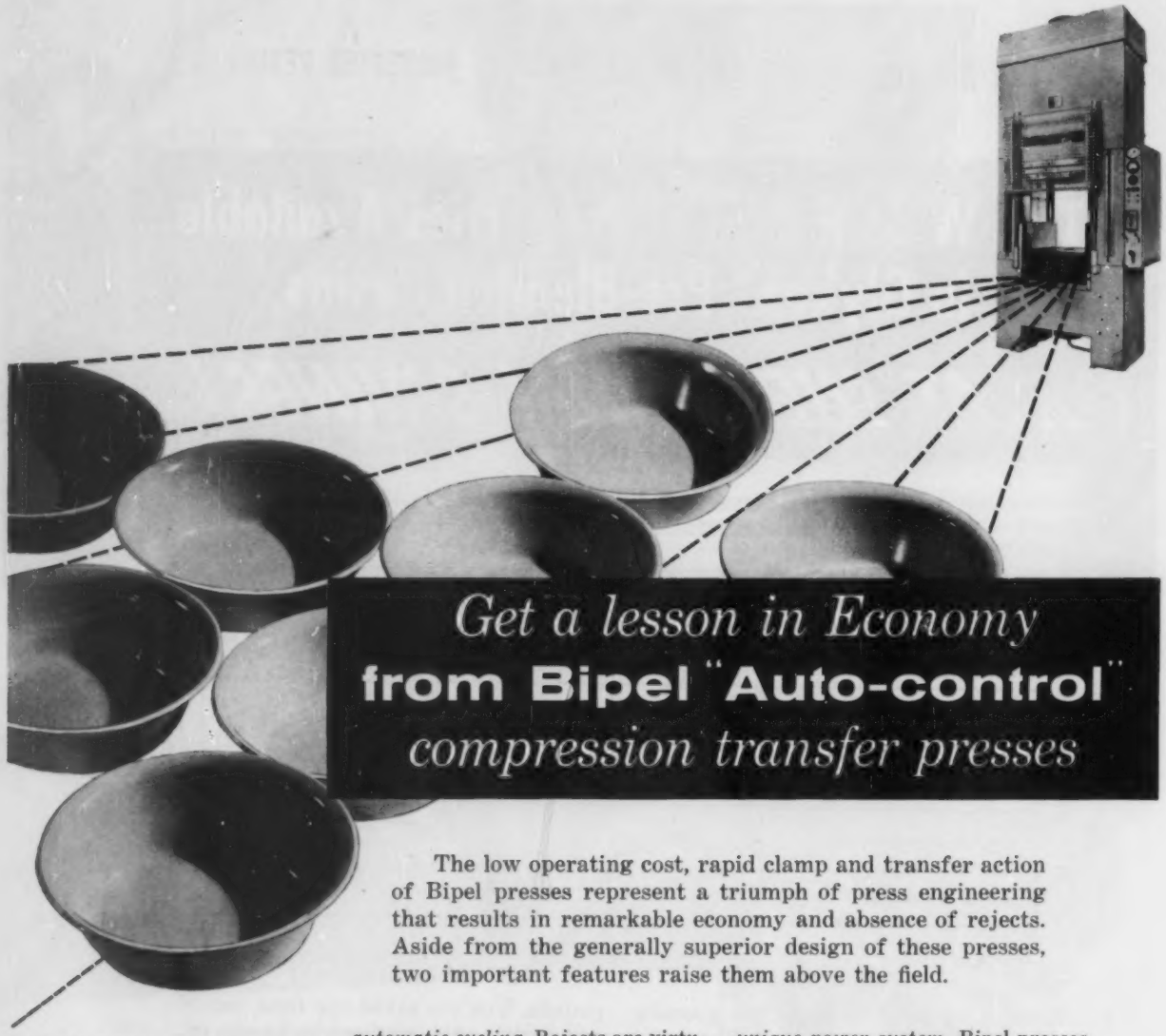
- ☐ Send sample of Glykon R-100 ☐ Glykon F-600
- ☐ Send sample of blend_____.
- ☐ Send literature on Glykon resins
- ☐ Have your representative contact us

Name_____

Company_____ Street_____

City_____ State_____

* TM GT & R CO. MP-9-54



Get a lesson in Economy from Bipel "Auto-control" *compression transfer presses*

The low operating cost, rapid clamp and transfer action of Bipel presses represent a triumph of press engineering that results in remarkable economy and absence of rejects. Aside from the generally superior design of these presses, two important features raise them above the field.

Melamine dishes moulded on a Bipel Type 40 are more alike than peas in a pod.

Type 40	20, 40 or 60 tons
Type 100	50, 100 or 150 tons
Type 200	100, 200 or 300 tons

automatic cycling Rejects are virtually eliminated by Bipel's patented "auto-control" which relieves the operator of all duties beyond loading the powder and pressing a button. The "auto-control" reproduces any type of cycle, including cycles which must be "breathed" during the cure, and those in which the material must be held under low pressure before full pressure is applied.

unique power system Bipel presses employ an outstandingly economical central power source that will drive up to twelve presses. A small version can be built within the press frame for single press installations. Power is used at the medium pressure at which it is supplied, or doubled or tripled by the presses' built-in intensifiers. Thus each press offers a choice of three working pressures.

Bipel's medium pressure-plus-intensifier system means that high pressures are encountered within the press only. Exterior piping and valves are relatively light and therefore inexpensive.

We would like to show you specifically how the installation of Bipel presses will lead to reduced costs and improved, increased production. Please ask for particulars.

Complete information on the Bipel pelleters and "auto-control" presses can be obtained in the United States from:

Ralph B. Symons Associates, Inc.
3571 Main Road
Tiverton, Rhode Island

B·I·P GROUP

B. I. P. ENGINEERING LTD.

Streetly Works, Sutton Coldfield, England

NEW, DIFFERENT, DEFINITELY SUPERIOR...

PITTSBURGH 508 PREFORM ROVING

All of our molding customers who have tried Pittsburgh's new #508 roving report excellent results. That's because PPG #508 really "outpreforms" other known types of roving in producing consistently better preforms.

PPG #508 Preform Roving is definitely superior because it has been treated by a special sizing process to insure better chemical and mechanical bond between glass fibers and molding resin. Results: consistently high quality moldings, lower scrap rate, faster preforming.

Check out PPG's new 508 Preform Roving on your own molding jobs and see the difference. You can get complete information on standard packages and available sizes by simply contacting our executive offices or our district sales offices in Chicago, Cincinnati, Cleveland, Detroit, Houston, New York, Philadelphia, St. Louis or Los Angeles. Pittsburgh Plate Glass Company, Fiber Glass Division, One Gateway Center, Pittsburgh 22, Pennsylvania.

FIBER PG GLASS

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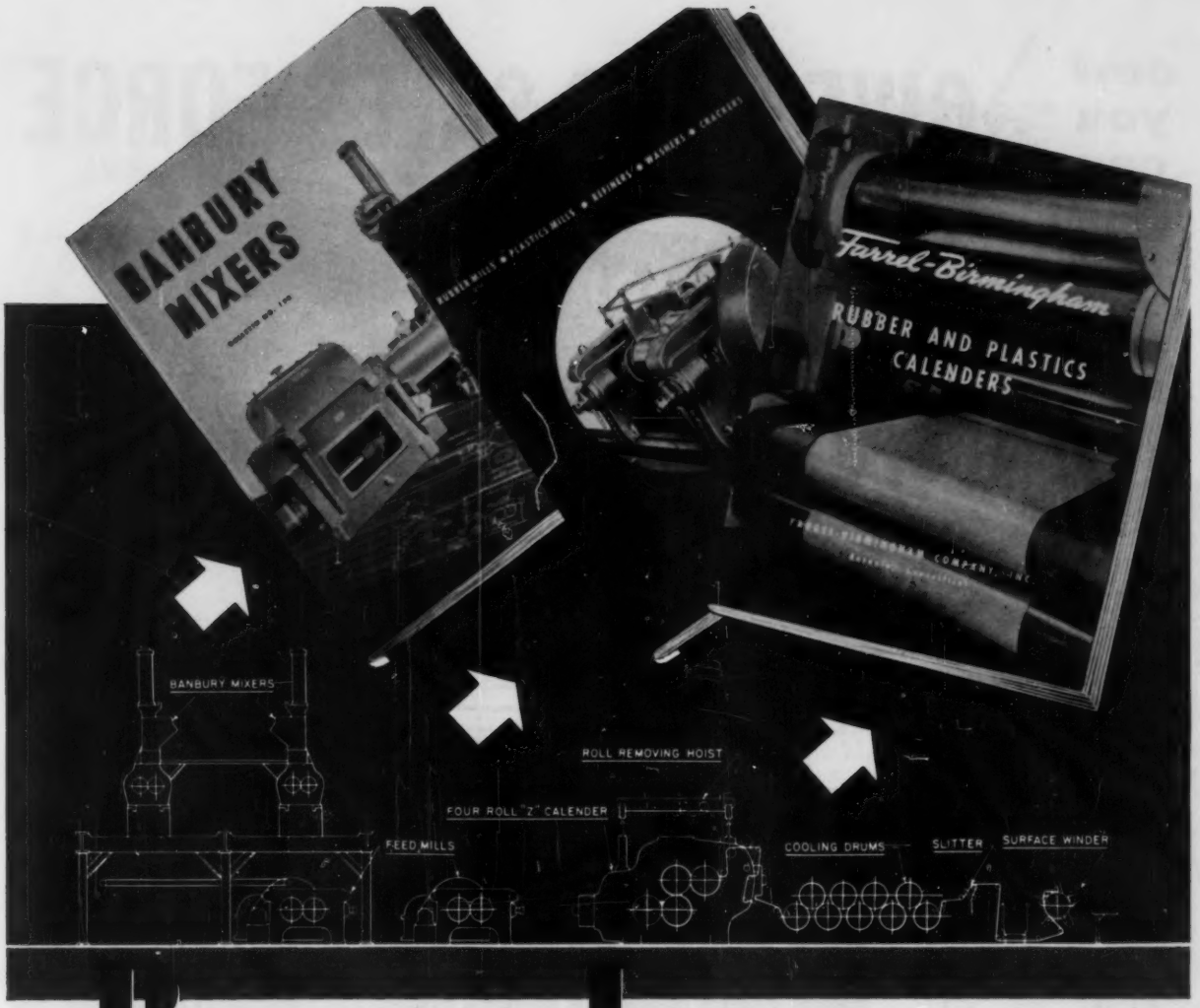
PITTSBURGH PLATE GLASS COMPANY



REFERENCE LIBRARY

for an efficient film production line

The three bulletins illustrated describe the major components of the processing setup blueprinted above. They contain details of the latest developments in processing methods and equipment, as pioneered by Farrel-Birmingham in the last few years, as well as illustrations, general specifications, information on related equipment and other pertinent data.

The processing setup is one of a number developed by Farrel-Birmingham to synchronize the progressive steps in the production of plastic film, sheet and coatings. These matched production units have given such satisfactory service that they have become generally accepted as standard equipment. For individual requirements, demanding greater or lesser output, larger or smaller machines with matched capacities are available.

Write for copies of these fact-filled bulletins today. There is no obligation.

FARREL-BIRMINGHAM COMPANY, INC.
ANSONIA, CONN.

Plants: Ansonia and Derby, Conn., Buffalo, N. Y.
Sales Offices: Ansonia, Buffalo, New York, Akron, Chicago, Los Angeles, Houston

FB-919

Farrel-Birmingham®

now you can

GIVE YOUR SALES FORCE

Superior Products of Varied Sizes and Shapes Can Be Vacuum Formed from Rigid Vinyl Sheets Made from EXON 450!

In end products as shown above, get excellent dimensional stability, needle sharp clarity of minute details. These exceptional characteristics are due to the unusual properties of the base resin used–EXON 450.

THE FINEST COMPETITIVE RIGID VINYL SHEET

The finest rigid vinyl sheets can now be processed with unusual economy. *One* resin—EXON 450—instead of *two*, can be formulated to meet ASTM D708 44T (Grade 1).

Fabricators of vacuum formed products have reported excellent results using rigid sheets processed from EXON 450. This superior resin is endowed with many outstanding properties. For example—

EXON 450

- maintains excellent color and clarity
- may be easily formed
- has excellent electrical properties
- does not support combustion
- takes a high surface finish
- has fine dimensional stability

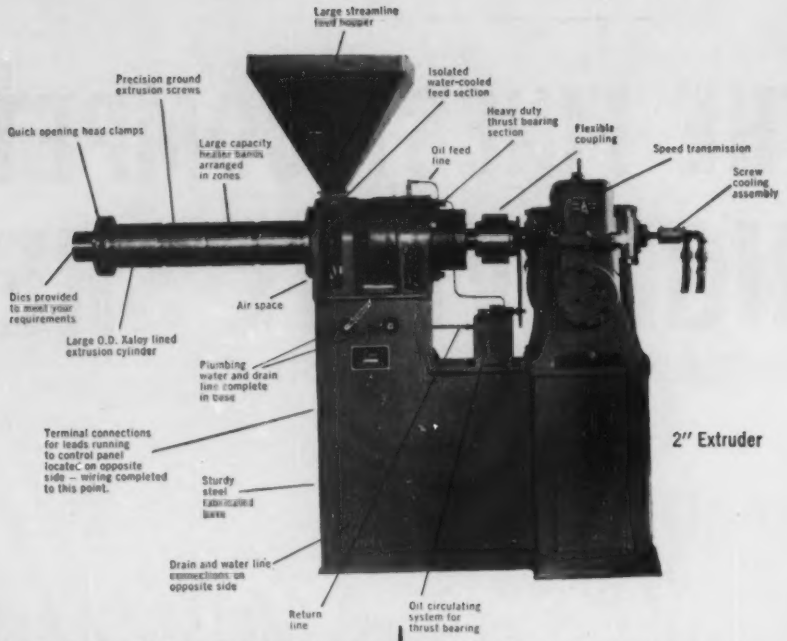
More and more, industry looks to Firestone for specific resins for specific needs. EXON 450 is one example. Whatever *your* problem, look for the answer in the ever-expanding line of versatile Firestone EXON resins.

For complete information or consultation on any processing problem... call or write

CHEMICAL SALES DIVISION

Firestone Plastics Co., Dept. 2E, Pottstown, Pa.
Division of the Firestone Tire & Rubber Co.

Egan plastic extruder



2" Extruder

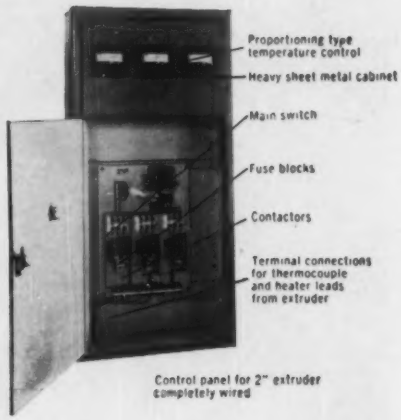
compare with the covers off!

Yes, when you remove the covers and get down to the bare facts of construction of this unique extruder, you will find a machine which will have longer effective screw lengths, greater maximum heating capacity, and larger thrust bearing capacity. This will add up to higher production rates, better products, and lower maintenance and operating costs. With the flexible design of the "extrusion" unit consisting of the separate components; screw, heating cylinder, feed section; and thrust bearing housing, we can give you any combination to meet your requirements.

EGAN EXTRUDERS are supplied complete with a *wired* control panel including the main disconnect switch, fuse blocks, contacts and temperature controls *mounted*. Plumbing for the water supply and return lines to the drain are completed in the base. Installation costs are held to a minimum.

EGAN EXTRUDERS can be furnished with dies, conveyors, take-off equipment and other auxiliary features for a wide range of extruded products.

Write for details or invite our representative to call



Control panel for 2" extruder completely wired

FRANK W. EGAN & COMPANY, Bound Brook, New Jersey

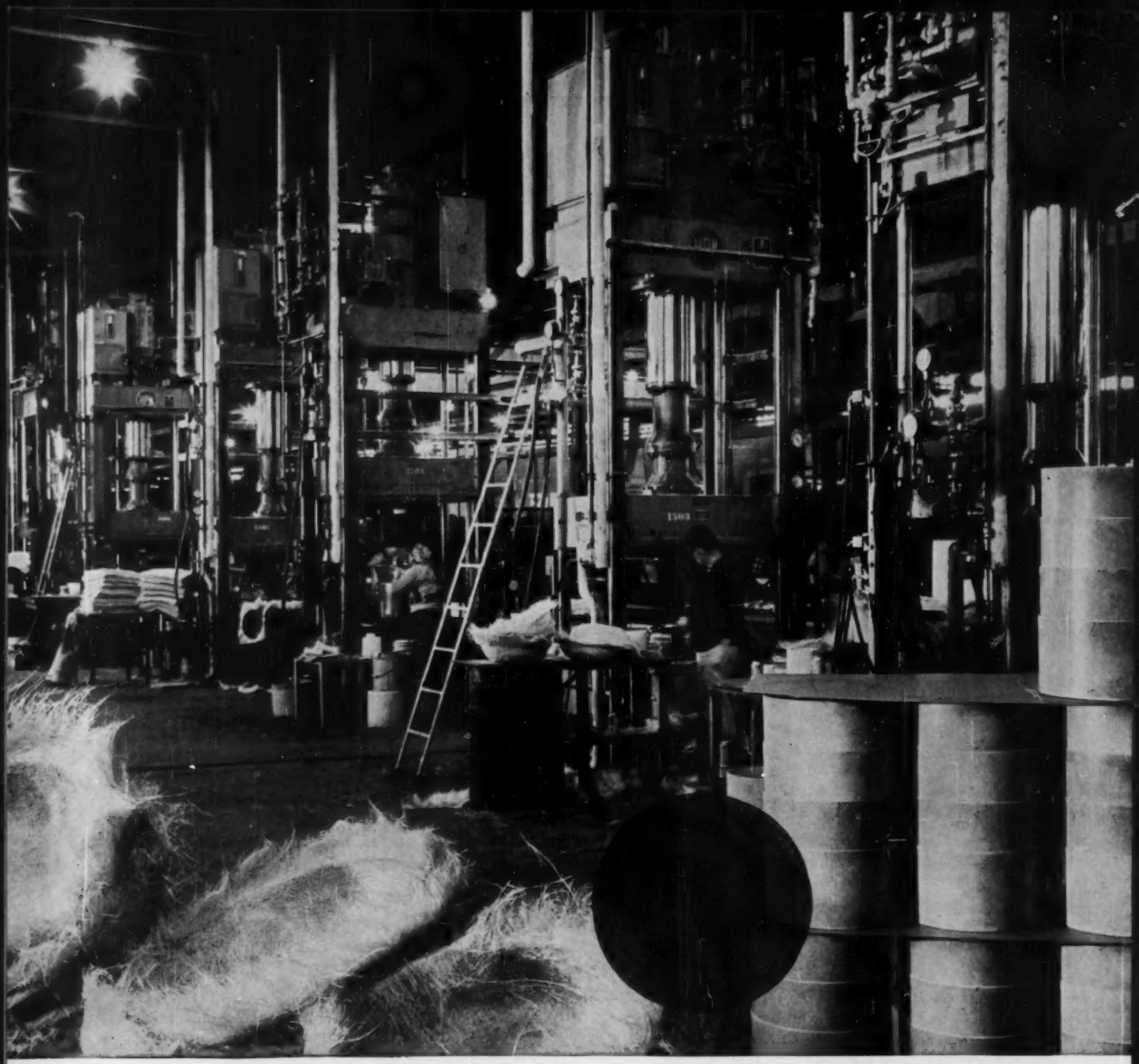
Designers and Builders of Machinery for the Paper Converting and Plastics Industries

Cable Address: "EGANCO"— Bound Brook, N. J.

Compare specifications of any standard Egan Extruder, size for size, with any other extruder.

Standard Sizes (Screw Dia.)—inches	2	2½	3½	4½	6	8
Effective Screw Length—inches	32	40	56	72	96	128
No. Cylinder Sections	1	1	1	1	2	2
Zones of Heating on Cylinder	2	2	3	4	4	4
Maximum Heating Load, KW	12	18	30	48	96	160
Thrust Bearing Capacity, 1000 lbs. @ 50 rpm.	60.5	60.5	119.5	208	288	420
Type Speed Transmission	Worm gear.	Worm gear.	Herr' bone	Herr' bone	Herr' bone	Herr' bone
Usual Motor Size, H. P.	7½-10	10-15	20-30	40-50	50-75	75-150
Approx. Extrusion Capacity lb./hr.	20-50	40-90	75-200	150-450	250-650	450-1200
Approx. Floor Dimensions—inches	40x98	48x112	60x120	84x132	96x156	104x192
Approx. Weight—lbs. (less Drive)	3200	3600	4800	6600	9600	12500

**Extruders are modified to meet requirements for a particular process*



need strength in your product? use plastics molded by General American

What kind of a strength would you like in your product? *Shock resistance*, like a survivors' kit that withstands parachute drops in rough terrain? *Structural strength*, like a TV cabinet? *Stamina*, for working parts, like a washing machine agitator? *All-weather toughness*, like a street light globe? General American has molded all these and more.

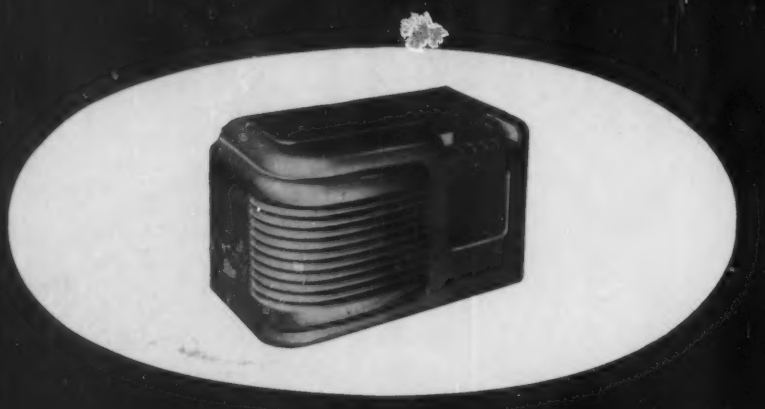
General American's molding facilities can often give your product strength in plastics that will outlast and out-perform conventional materials . . . plus new lightness, beautiful color and big volume production. Ask a General American engineer for ideas to help you.

PLASTICS DIVISION
GENERAL AMERICAN
TRADE MARK

PLASTICS DIVISION
GENERAL AMERICAN TRANSPORTATION CORPORATION 135 South La Salle Street, Chicago 90, Illinois

Facilities unmatched anywhere: injection presses to 300 ounces, compression presses to 2,000 tons, reinforced plastics molding, die making, painting, assembly, packaging

for **TOUGH** molding jobs . . .



METASAP* STEARATES deliver easier mold release

When you have a tricky molding problem . . . when you're deep drawing or producing large pieces, Metasap Stearates in the molding compound provide outstanding lubrication for easy ejection from the mold.

Either incorporated into the molding compound or dusted onto mold surfaces Metasap Zinc or Calcium Stearates give outstanding lubrication so that lower ejection pressures are needed. Thus, you can expect increased output, fewer rejects, improved finished products and longer mold life.

So specify compounds containing Metasap Stearates or incorporate them directly into your own molding compound. Metasap Technical Service will help you with the proper material and mixing procedure for your needs.

. . . and to produce economical plastigels

As a thickening agent for plastisols, Metasap provides a complete line of quality Stearates. We'll be glad to make available to you free experimental samples of Magnesium, Barium, Calcium and Aluminum Stearates. They are ready for immediate shipment now.

METASAP CHEMICAL COMPANY
Harrison, N. J.

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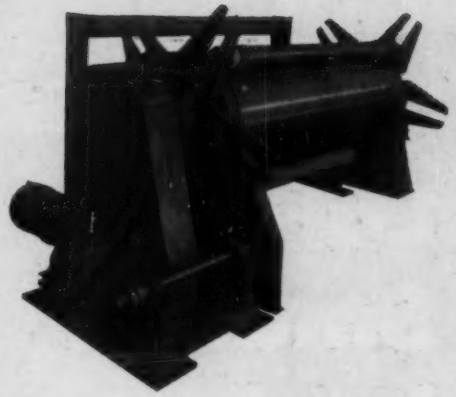
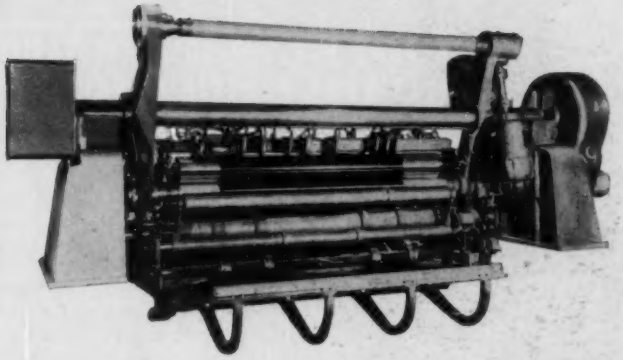
METASAP STEARATES
the cleanest stearates made

"Ferristart" Surface Winder for film and sheeting with manual continuous starts on new cores. Convenient to operate, convenient to remove finished rolls for packaging. Applicable at speeds up to 75 yards per minute.

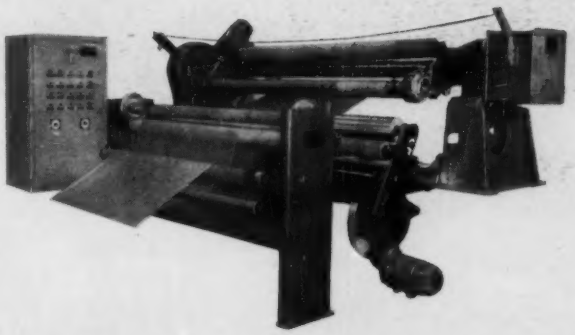


PLASTIC WINDERS

Continuous surface or center winder for film and sheeting for a wide range of gages, tensions, speeds, widths and roll diameters.



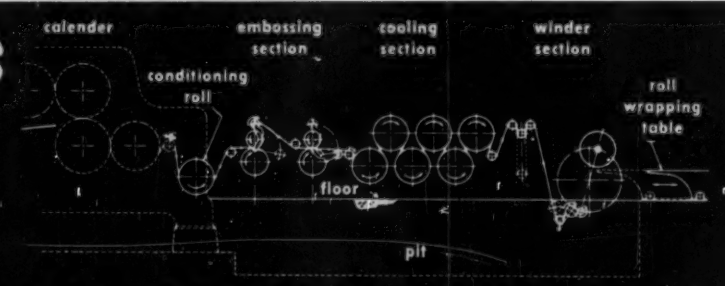
Fully automatic Model 40-S center wind for sheeting Square even starts without adhesive on the core. Full tension control Slit webs can be wound side by side.



Fully automatic Model 40-F center wind for film at speeds up to 150 yards per minute. Even starts without fold back. Full tension control thru a range of 6# total minimum to 45# maximum on full width web.

THE BLACK-CLAWSON COMPANY
DILTS MACHINE WORKS DIVISION
Fulton, New York

Dilts



Cooling Drums
Embossers
Winders
Polyethylene Laminators

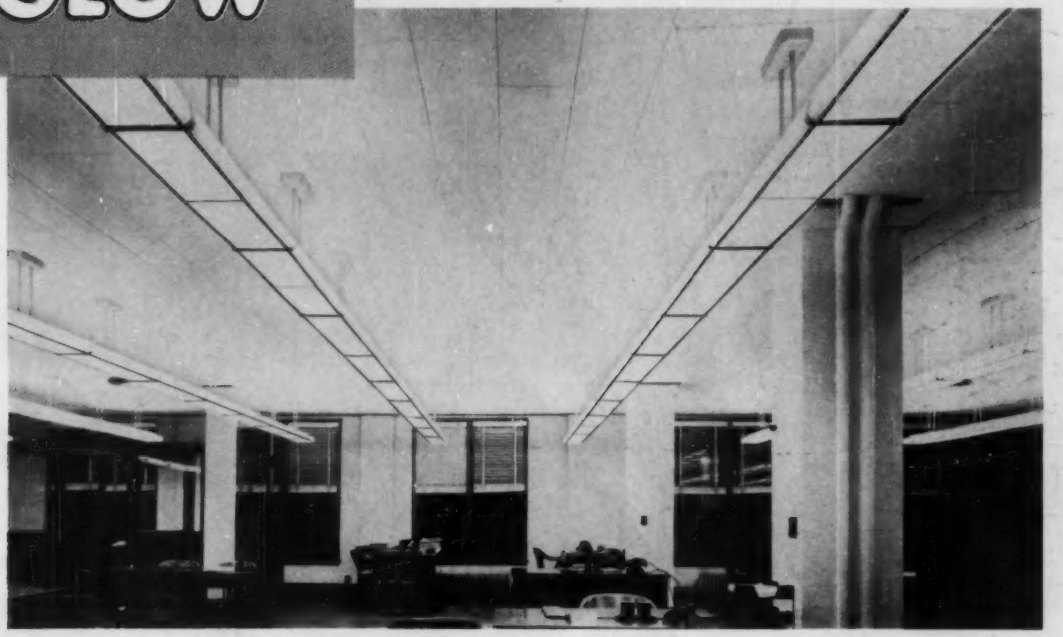
COMPLETE PLASTIC TAKE-OFFS


Large...
Small...
Intricate...
BRIDGEPORT HAS THE COMPLETE FACILITIES TO MEET YOUR PLASTIC MOLDING NEEDS
Bridgeport offers complete modern Engineering and Mold Construction facilities to produce precision moldings in all Thermoplastic and Thermosetting materials — Phenolics, Urea, Melamine, Polystyrene, Polyethylene, Lucite, Plexiglas, Acetate, Butyrate, Nylon, and many others.
Bridgeport molds Products in a wide variety of sizes and forms ranging from tiny instrument parts to large refrigerator door panels. These products are molded by Injection, Compression, Plunger, and Automatic processes on equipment up to 200 ounce Injection and 452 ton Hydraulic Compression Presses.
We welcome the challenge of new products and problems. Write for complete details.
BRIDGEPORT MOULDED PRODUCTS INC., Bridgeport 5, Conn.

from GLOOM to GLOW

BEFORE: *The old globe lights glared, and the illumination was low.*

AFTER: *Now the National Bank of Detroit has effective uniform lighting. Lighting fixtures—Skyray #1046—supplied by the Electro Silv-A-King Corp., Chicago, Illinois and Bridgeport, Conn.*



—with EVENGLO® polystyrene panels

NATIONAL BANK of Detroit recently modernized the lighting in its main office. In place of the old globe lights, it installed new fluorescent fixtures with "Evenglo" components. To provide this pleasant, effective illumination, the Electro Silv-A-King Corp. chose the "Evenglo" polystyrene formulation that had the exact color, light transmission and diffusion desired.

You, too, may specify the color tone of light, degree of brightness and amount of diffusion needed in your lighting fixtures when you require that the components be made of "Evenglo" polystyrene. You'll find, too, that building owners like this Koppers Plastic because it is easy to clean, holds its shape, and looks trim.

Koppers application engineers will be glad to assist you in selecting the specific "Evenglo" formulation you need to get the lighting results you want. For more information write to us today.

KOPPERS®

Koppers Plastics Make Many Products Better and Many Better Products Possible.

Koppers Plastics

KOPPERS COMPANY, INC., Chemical Division, Dept. MP-94, Pittsburgh 19, Pennsylvania

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We'll put our cards on the table...

when bidding for your molded plastics orders

When you come to us for advice on your plastic molding needs, we'll give it to you straight. Our full house* of the latest, most modern molding machinery is your ace in the hole to beat increased competition. When the chips are down, it pays to have Aico as a partner. Let's arrange a friendly get-together and talk it over. Drop us a line today

AMERICAN INSULATOR

Since 1916

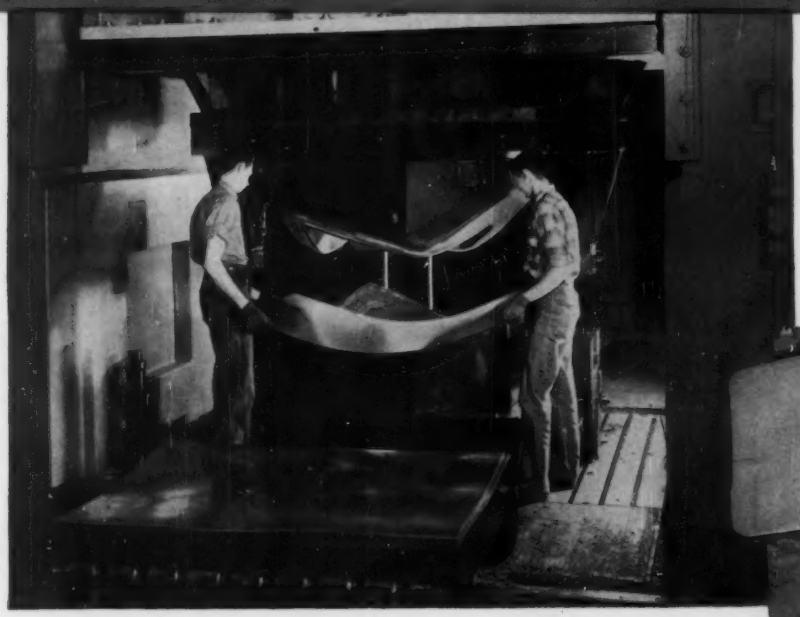
NEW FREEDOM, PA.

*a complete molding service

including engineering counsel, mold making, transfer, compression, injection and cold molding plus the molding of reinforced plastics. With this array of services, Aico is in a position to make unbiased recommendations to your best advantage.

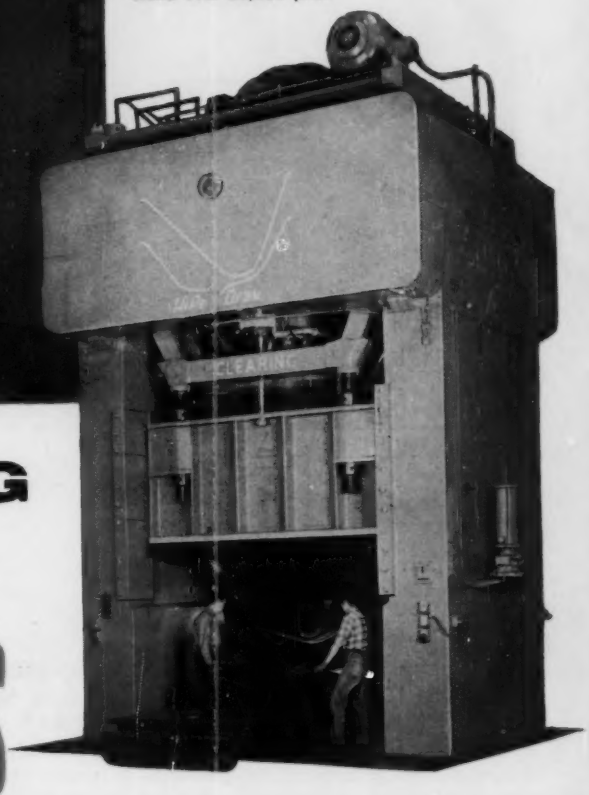
MODERN PLASTICS

SEPTEMBER 1954 VOLUME 32 NUMBER 1



Courtesy Chrysler Corp.

Fig. 1 (left)—Cast phenolic die with fibrous glass-epoxy resin shell is used to stamp truck body parts from sheet steel. Fig. 2 (below)—Mounted in a 600-ton press, the die can withstand over 20,000 p.s.i.



METAL WORKING SWINGS TO PLASTICS TOOLS

IN THE few years of its existence, plastic tooling has developed into a big business for several major metal working companies—and, as soon as more personnel trained in this special art becomes available, it bids fair to become big business for many, many more.

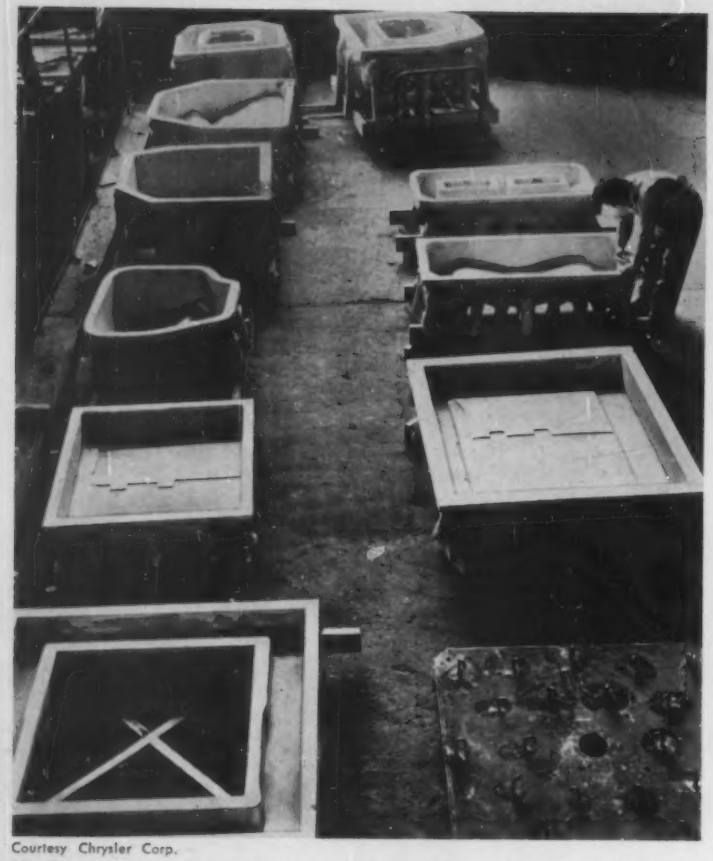
Even though this branch of the plastics industry is still in its infancy, there have already been thousands of forming dies, jigs, and fixtures produced to date. One of the "big three" in the automotive industry, for example, is now producing a forming die for the steel top of a large sedan. The die will be over 10 ft. long and will weigh 12 tons, approximately half of which is polyester and the other half glass. It was estimated that this die, if made in metal, would have cost $110,000 and would have taken several months to complete. The plastic die, in contrast, will cost approximately $30,000 and will be completed in a fraction of the time that would have been required for the metal model.

A plastic die, also for forming a car top, has been installed with success by another leading automobile manufacturer. While somewhat smaller than the one above, this second tool is still a massive piece of construction. The die has a boiler plate base on which is mounted a core material. Over the core is an epoxy casting which functions as the forming surface.

Production Economies

Grumman Aircraft Engineering Corp. uses no metal dies at all in its Aluminum Stretch-Forming Div. All stretch-forming dies are made up with the forming surface of cast phenolic.

In contrast to those large compa-



Courtesy Chrysler Corp.

Hardened plaster molds cast to the exact size and shape of the desired plastic tool are ready for the initial lay-up of epoxy resin-impregnated fibrous glass cloth

nies which do not use plastics dies, Grumman has effected many production economies by installing the cast phenolic tools. In the Tool and Die Dept. of Grumman, for example, only one Keller machine is used. Other aircraft companies still using metal dies have as many as 8 Kellers going steadily around the clock in order to keep up with the necessary barbering operations on the metal dies.

Chrysler Corp., another one of the large companies joining the swing to plastic tooling, recently announced the addition of a group of plastic dies to the production line at the De Soto press plant in Detroit. These dies are now stamping out 11 different steel parts for a Dodge cab-over-engine truck. Each die is constructed of a fibrous glass-epoxy resin shell backed up with cast phenolic.

Figure 1 shows one of these large dies turning out a hood side panel for the cab of the truck. The die measurements are 48 by 36 in. and the depth of draw is 7 inches. The two halves of the die weigh a total of only 3600 lb.—far less than they would have weighed in metal. Figure 2 shows an over-all view of the mammoth 600-ton press in which the side panel die is mounted.

It is estimated that the 11 dies would have cost $\$1/2$ million and would have required from 32 to 36 weeks to complete, if made of metal. The 11 plastic dies were in operation at the end of 16 weeks. In addition, although the actual cost of the plastic dies can not be divulged, one executive of the Chrysler Corp. stated the savings were in excess of 30 percent.

MATERIALS

Beginning with the early days of World War II, the use of plastics for tooling has shown a remarkable expansion, primarily in the aircraft industry. In a relatively short time, plastics have spread from the manufacture of simple drill jigs or routing fixtures into the field of forming dies for aluminum, as well as for heavy-gage steel parts.

The first plastic used for making jigs and fixtures was a phenolic laminated board. Since this material was available only in flat sheet, and had to be cut and shaped to size, and since the final fixture had to be bolted and doweled together much the same as had to be done with wood or metal, it did not offer any great savings in manufacturing costs. On the other hand it was relatively lightweight—being only one-sixth as heavy as steel—and it was easy to drill, file, or saw.

Reinforced Plastics

The real jump in the use of plastics for jigs and fixtures, however, came with the advent of the polyester resins and fibrous glass reinforcements. Using these reinforced plastics, it became possible to mold to contour, with the use of little or no heat or pressure, a stable, tough fixture. Semi-skilled or unskilled labor was adequate for practically every type of tooling job, ranging from simple trim fixtures to complicated drill and assembly units, and including nesting fixtures, installation fixtures, welding fixtures, and routing fixtures.

The basic procedure for making a drill rack illustrates the simplicity with which a reinforced plastics fixture can be produced. As the first step in the manufacture of the rack, a plaster master of the part to be trimmed is made. If the untrimmed part itself were available it would be imbedded in the surface of the plaster and backed up with additional material of the same kind. The second step in the production line involves the application of a suitable parting agent to the plaster mold. Resin is then mixed with the proper catalyst, depending on whether a room temperature or oven cure is desired, and is applied to the successive layers of glass cloth as they are laid up on the plaster mold. Sufficient layers of impregnated cloth are built up until the required thickness has been reached. If a room temperature cure were desired, the embryo tool would then be allowed to stand until it had cured. If an oven cure were wanted, the whole plaster and laminate layup would be encased in a polyvinyl alcohol (P.V.A.) "bag" and a vacuum drawn from within. The whole unit would then be moved into an oven for cure (see Fig. 3).

After cure, the drill rack is cut and filed to proper trim line and the bushings are located and bonded in place (see Fig. 4).

Pre-Impregnated Cloth

It is interesting to note that although refinements have been made in the procedure outlined above, it has remained basically the same to this day.

Some of these refinements in fixture production are noteworthy. The most important of these was the development of pre-impregnated reinforcing glass cloth. It was found that glass cloth could be soaked in polyesters and allowed to pre-gel so that a catalyzed, slightly sticky, resin-saturated cloth resulted. The pre-impregnated cloth had such desirable characteristics as "tack" and "drape" which make for a neat, clean, and rapid layup of the tool. The cloth also makes it possible for an incompleted tool to be left overnight without fear of it "kicking over." The pre-impregnated layup requires an oven cure and vacuum bag pressure.

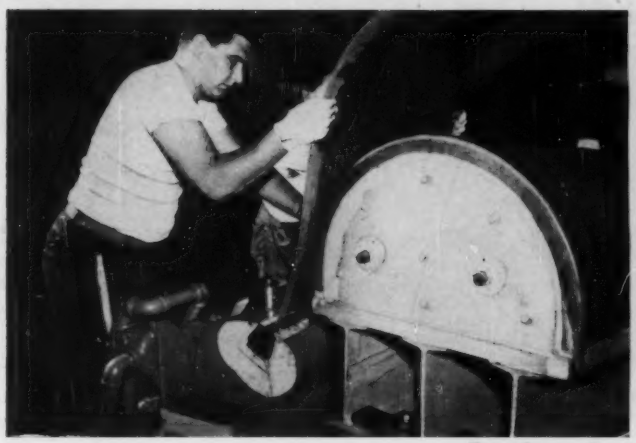
Another refinement of the early laminate tooling methods involved the use of molded-in reinforcements. It was found, for instance, that large, almost flat contours had a tendency to warp out of shape when cooling unless a series of stiffening ribs were incorporated. These ribs could be made of steel plate, masonite, or CCA and were molded directly into the tool to increase its stability.

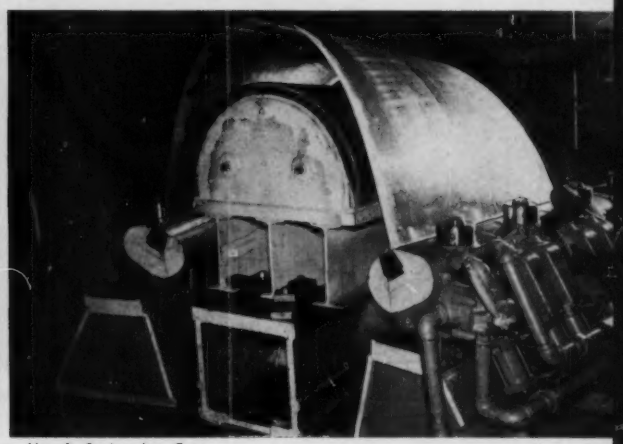
Tooling Stability

Metal strips can also be molded into laminates at points of wear, such as the edge of a routing fixture or in the area of a locating pin for a trim fixture (see Fig. 5).

The stability of laminate tooling is illustrated by the fact that certain plastic drill and assembly fixtures have been in constant service at Republic Aviation Corp. for seven

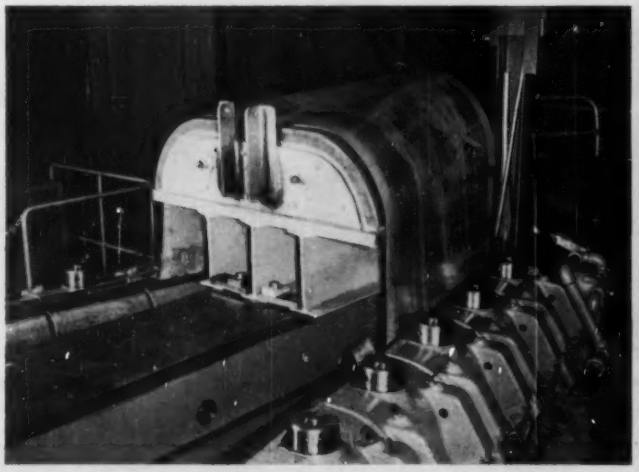
STEPS IN THE USE OF A PLASTIC STRETCH DIE

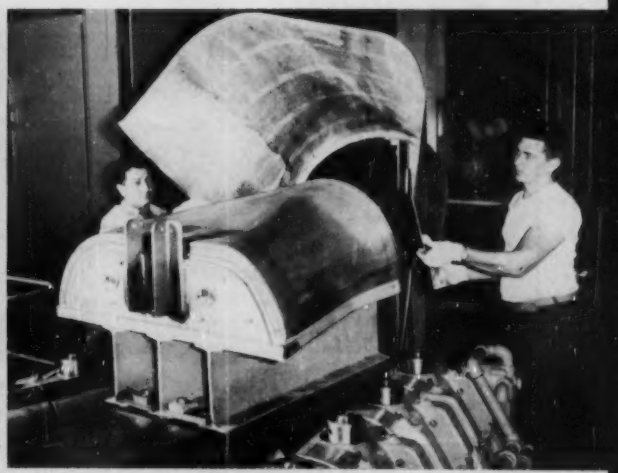




Photos Courtesy Grumman Aircraft Engineering Corp.

Cast phenolic die, which will be used to form an aircraft panel from a sheet of aluminum, is mounted in a stretch press. Both edges of sheet . . . . . are locked in place between the jaws of clamps on either side of the press (left) and the sheet is bent over the die (above)





Phenolic die is then raised into contact with the aluminum sheet and sufficient pressure is exerted against the sheet to stretch it into shape

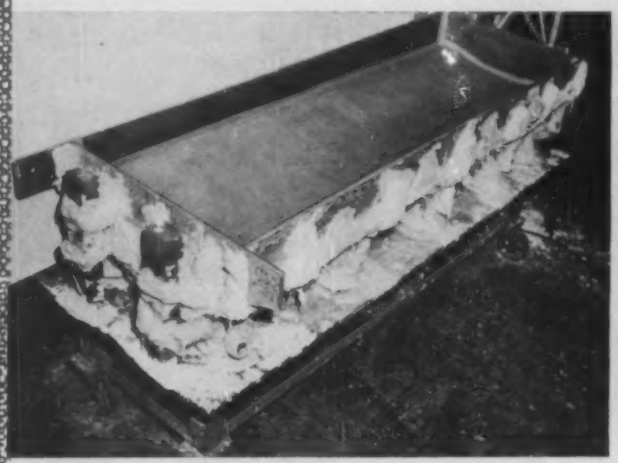
After the hydraulically actuated clamps have been opened, the formed piece is removed from the stretch press by an operator

DRILL RACK—STRETCH DIE—MASTER—CHECKING FIXTURE

Photos both pages courtesy Republic Aviation Corp.

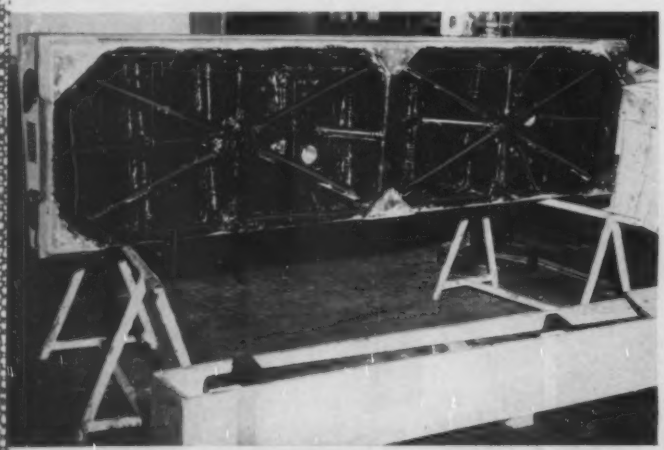
DRILL RACK. Fig. 3—Impregnated glass cloth is first laid up on plaster mold, then covered with P.V.A. bag, under which vacuum is drawn . . .

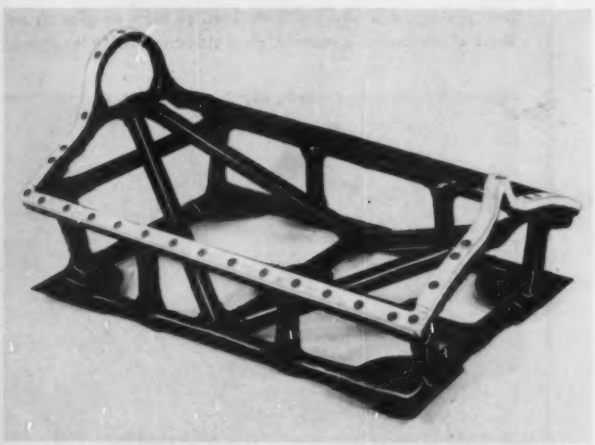
. . . Fig. 4—After oven cure, the finished reinforced plastics rack is cut and filed and bushings are located and bonded in place . . .



STRETCH DIE. Fig. 6—Build-up of temporary plywood sides on cast plaster mold is basic step in production of phenolic die . . .

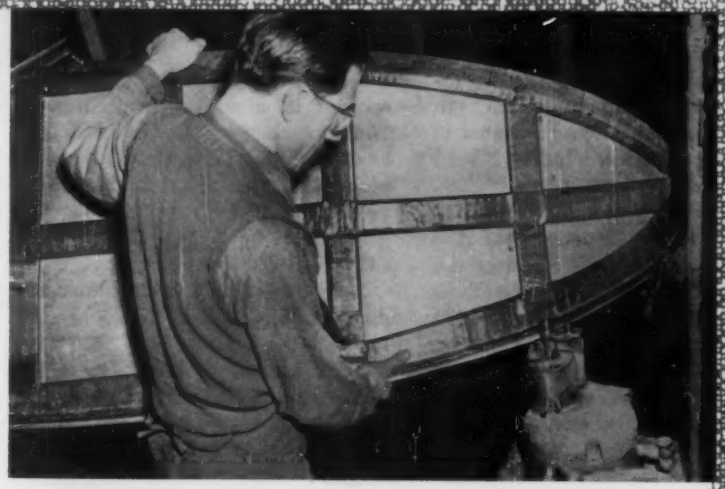
. . . Fig. 7—Phenolic resin is then poured into the mold and allowed to cure. When sufficiently cool, tool is removed from mold



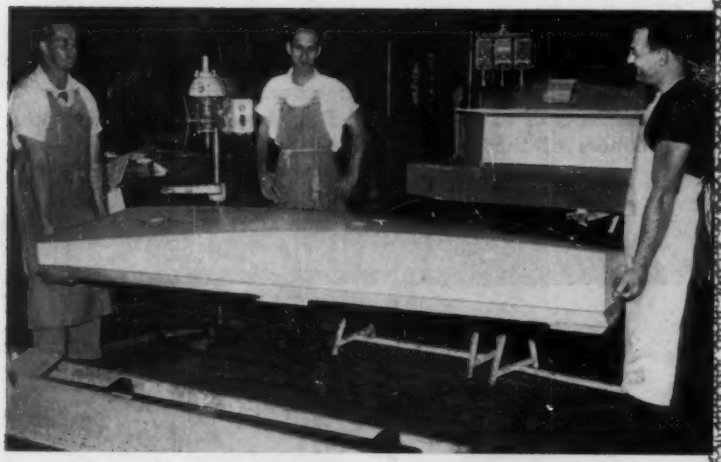


. . . Fig. 9—Underside of the rugged reinforced plastic duplicate master is reinforced with trusses of paper-base phenolic tubing

CHECKING FIXTURE. Fig. 10—Epoxy resin-fibrous glass fixture is made directly against a master to ±0.003 inch



. . . Fig. 5—At points of wear, such as the edge of a routing fixture or in the area of a locating pin (above), metal strips can be molded into the laminate



DUPLICATE MASTER. Fig. 8—Epoxy resin-impregnated fibrous glass duplicate master of wing pylon area weighs 210 lb., replaces 3100-lb. metal tool . . .

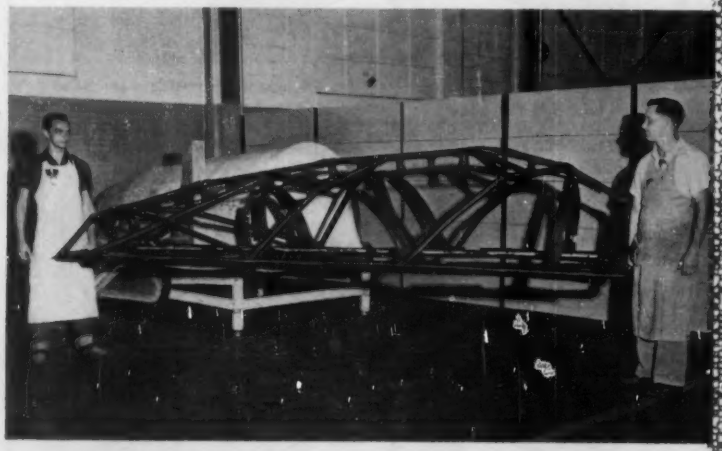


Fig. 11—Another lightweight checking fixture, measuring 12 ft. in length, was made directly on cast plaster mold (background) in approximately 50 man-hours

years and still show no perceptible change in dimension.

Concurrent with the development of polyester laminations was the introduction of casting phenolics for tools. Early attempts made in this direction were fraught with failures, primarily due to the high shrinkage characteristics and poor weatherability of the material. It was not until 1950 that dependable resin-filler-catalyst combinations became available and cast phenolic tooling began to boom. The attractive price of casting material, coupled with the fact that no skilled labor was required in the tooling process, helped phenolic tooling to replace both ferrous and non-ferrous metals in many applications. Checking fixtures, nesting fixtures, Guerin press blocks, Keller patterns, master forms, and stretch forms are all admirably suited to cast phenolic tooling.

Fabricating Cast Phenolics

The fabrication process used at Republic Aviation Corp. for making fixtures, for example, illustrates the ease with which phenolic tools can be cast. The process follows this general pattern:

1) A plaster mold is first made to the exact size and shape of the tool to be cast and is thoroughly dried. (See Fig. 6.)

2) A suitable parting lacquer is then applied to the mold surface. After it is dry, a wax is applied.

3) The resin, filler, and catalyst are mixed in the proper proportions and poured into the mold through holes prepared in the inverted base.

4) The resin is cured for several hours at room temperature, after which the mold and resin are heated in an oven to complete the cure. (Quick-setting room-temperature cure resins are also available.)

5) The casting is finally cooled slowly to room temperature and removed from the plaster mold—a finished tool. (See Fig. 7.)

When large tools are made, it is customary to use a low-density phenolic foam core to limit the inherent exothermic heat with its resultant shrink. The foam core, which weighs roughly one-fifth as much as the casting material, saves many pounds of phenolic in a large tool and reduces the over-all weight.

As with the polyester laminations,

many refinements were made in the fabrication of cast phenolic tools. Large stretch forms, for example, were initially made with a plywood eggcrate core and base. It soon became apparent that this construction required too many man-hours to make, was not sufficiently moisture resistant, and required too deep a section in order to achieve the necessary rigidity. A boiler plate base, to which structural steel "I" beams were welded, was found to be a cheaper, sturdier, and more durable core, and this has developed today into the more popular type of construction. To fill the major part of the volume in the unit and to tie in the steel base to the phenolic shell, phenolic foam is used.

The Epoxies

Within the past two years a new family of resins has appeared on the tooling horizon that promises to outperform all others. This family is called the epoxies. Basically, the epoxies are polymers of epichlorohydrin and bisphenol which, both with and without standard reinforcement, offer outstanding strength properties and excellent resistance to shinkage which have hitherto been unobtainable.

Epoxies have been in use for several years as an adhesive, but it is only recently that the price of the resin has come down low enough to allow its use in tooling. The versatile epoxies can be used as laminating resins, casting resins, or bonding resins, and in each case they turn in a superior performance. They are generally room-temperature cured, but a short oven cure is recommended to develop strength fully. They can be filled with a variety of materials, ranging from glass flocking to aluminum dust. They can be cured in any length of time merely by selecting the proper catalyst, and the cured plastic can be made to have a Barcol hardness of 65 or to drop off the bottom of the scale simply by adding the proper ingredients.

Several companies market tooling epoxies in a convenient two-container packaging system that includes one can of resin and one can of hardener (catalyst) to be mixed before use.

Production Line

A typical epoxy resin duplicate master tool would be made as follows:

1) A plaster splash is taken of the master to be duplicated.

2) The plaster face is dried and then evenly coated with a parting lacquer.

3) Epoxy resin is catalyzed, mixed, and brushed on the surface of the plaster. This surface coat is then allowed to gel.

4) Successive layers of glass cloth are applied to the tool face and saturated with resin.

5) Reinforcements of steel plate, phenolic board, or phenolic tubing

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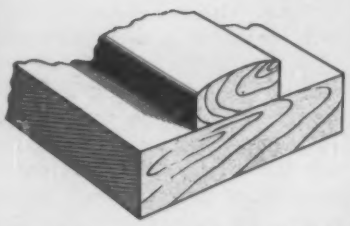


Illustrations both pages courtesy Ren-ite Plastics, In

Fig. 12—Coating wood model with wax is initial step in making epoxy die

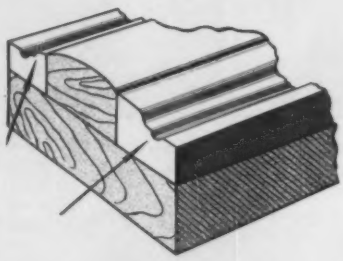


Fig. 13—Clay, wood, or plaster runout (arrows) is then added to the model

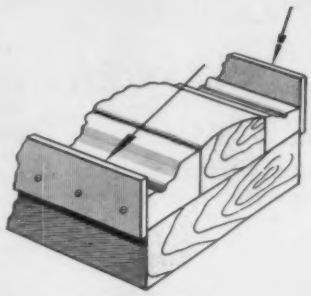


Fig. 14—Dam (arrows) is also added to prevent liquid resin from running over

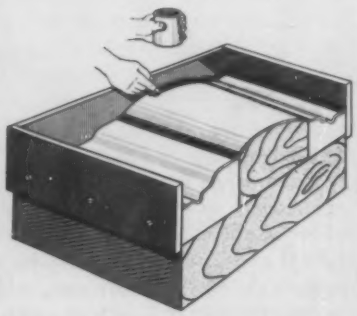


Fig. 18—Sharp corners are filleted with epoxy resin-fibrous glass paste

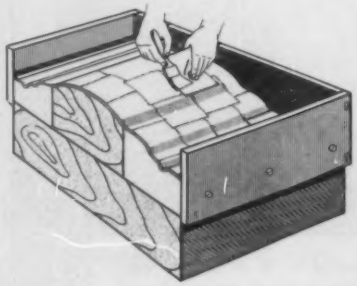


Fig. 19—Tailored sections of glass cloth are next laid up in the resin

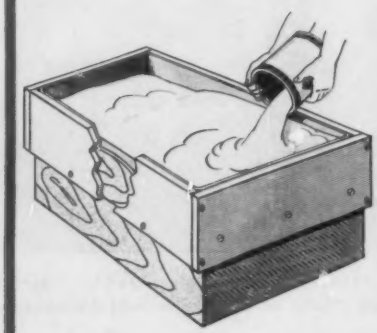


Fig. 20—Casting resin is then poured into the cured epoxy resin-glass shell

are used where necessary and tied in with a filled epoxy paste.

6) The resin is allowed to cure at room temperature and is then removed from the plaster.

Large tools made in this way have been found to hold an accuracy of ± 0.002 inch. Figure 8 shows a duplicate master of a Republic F84F wing pylon area made of glass cloth-reinforced epoxy resin. Figure 9 shows the underside of the tool indicating the hollow trussed construction. The reinforcement is 2-in. O.D., ⅛-in. wall, paper-base phenolic tubing. It is interesting to note that the center sag of this tool, when suspended from its ends, was less than 0.001 inch. Figure 8 also illustrates one of the prime advantages of all plastics tooling—light weight. The 240-lb. tool that the two men are lifting replaced a 3100-lb. Kirksite equivalent that had to be mounted on a special 1000-lb. dolly to prevent it from sagging as much as ⅜ in. under its own weight.

Checking tools of all sorts are fertile ground for the epoxies. Their lack of shrink in curing allows them to be molded directly against any configuration. Since no heat is required for cure and the exothermic heat generated by the material itself can be controlled by layup techniques, fear of warpage in curing is virtually eliminated. Figure 10 shows a contour-trim-hole location checking fixture which was made directly against a master to an accuracy of 0.003 inch. The bushings were emplaced by drilling oversize holes in the correct areas, mounting the bushings on pins protruding from the master hole bushings, and pouring epoxy resin around the hole. The accuracy obtained in this manner enables a tolerance of ± 0.0005 in. to be kept between any two holes on the fixture.

Another type of checking fixture for checking large compound curvatures can be quickly, cheaply, and accurately made of epoxy laminates. This is illustrated in Fig. 11 where a 12 ft. long fixture, designed to coordinate the mating of various external assemblies in the cockpit and turtledeck areas of the Republic Thunderstreak, was needed in a hurry. The tool took only 50 man-hours to build and was made directly on the original cast plaster master mold. The ease of handling of the large fixture, which weighed 75 lb., also earned the praise of all those who were involved in the project.

TECHNIQUES

There are many different variations in the methods and techniques used to produce metal forming dies with plastics.

In making an epoxy tool, for example, several techniques are available for producing forming and draw dies, drop hammer dies, hydro-forming dies, and some types

PRODUCING PLASTICS DIES

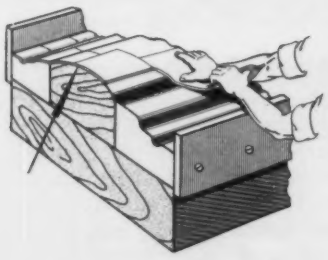


Fig. 15—Pattern maker's sheet wax (arrow) is laid on surface of the model

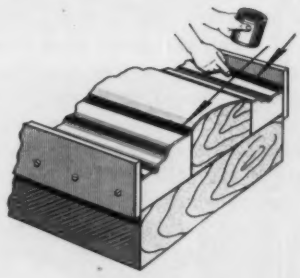


Fig. 16—Corners and fillets (arrows) are radiused by filling with fillet wax

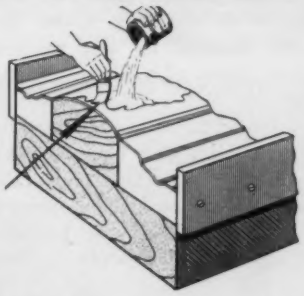


Fig. 17—Epoxy resin is then brushed (arrow) onto the prepared surface

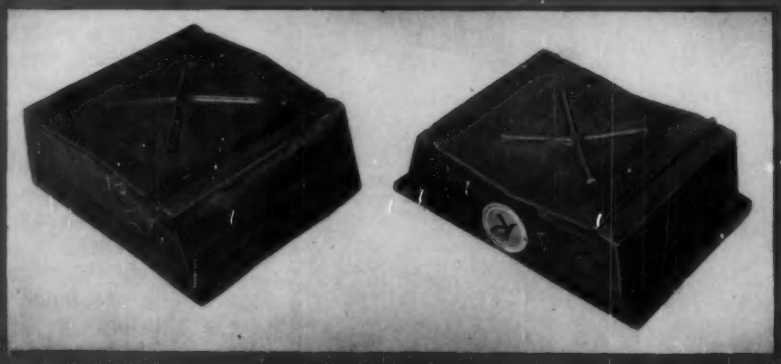


Fig. 21—Drop hammer die produced by this method has stamped out 3500 parts

of blanking dies. In most every case, however, the face of the die is a laminate shell which must be entirely free of voids. This shell in turn is backed up with a shrink-free and void-free cast material.

Epoxy Dies

The following step-by-step procedure is the method recommended by Ren-ite Plastics Inc., Lansing, Mich.

A wood model is first made and coated with a paste wax. The coating is polished out on the surface of the model but is left unpolished on the frame and base (see Fig. 12). This initial waxing step is not required if metal thickness wax is going to be used in one of the later steps in the operation.

Wood, clay, or plaster is then added to the wood model in order to provide for the development of the required draw condition (see Fig. 13). A dam which is designed to contain the resin when it is poured (see Fig. 14), is added all around the wood model. Pattern makers' wax sheets, the same thickness as the metal to be stamped by this die, are then added to the surface of the pattern (see Fig. 15). The joints of the wax sheets are carefully blended by wet sanding with sand paper of a fine grade and gasoline.

Corners and fillets are radiused by filling with fillet wax (see Fig. 16). After the entire surface and walls of the build-up are then sprayed with a parting agent, a coat of paste wax is applied with a brush and the excess is removed. This wax coating should not be polished out.

The next step in the production of the die calls for the application of the epoxy die surface coat mixture. The required quantity of specially formulated resin is mixed with the necessary amount of hardener, poured out onto the prepared surface of the part, and spread out with a brush (see Fig 17). A uniform coating of from 1/32 to 1/16 in. is the preferred thickness. The coating should be allowed to become tacky before proceeding with the next step.

Completing the Die

All sharp corners should be filleted with a paste made up of chopped glass fibers and activated epoxy resin (see Fig. 18). This step simplifies the elimination of any air holes occurring beneath the fibrous glass lay-up which is to be applied next. A quantity of laminating epoxy is then combined with hardener and a coat is applied to the surface of the pattern.

Tailored sections of fibrous glass cloth are next laid up in the wet resin and are smoothed or stippled into place with a brush. This is a very important step in the production of a die, and great care should be taken to be sure that the fibrous glass cloth makes intimate contact throughout the entire area. Additional sections of resin impregnated fibrous glass cloth are laid up until the shell reaches a thickness of from 1/2 to 5/8 in. (see Fig. 19). When the resin has set up, but is not entirely cured, the excess cloth which extends above the build-up is trimmed off.

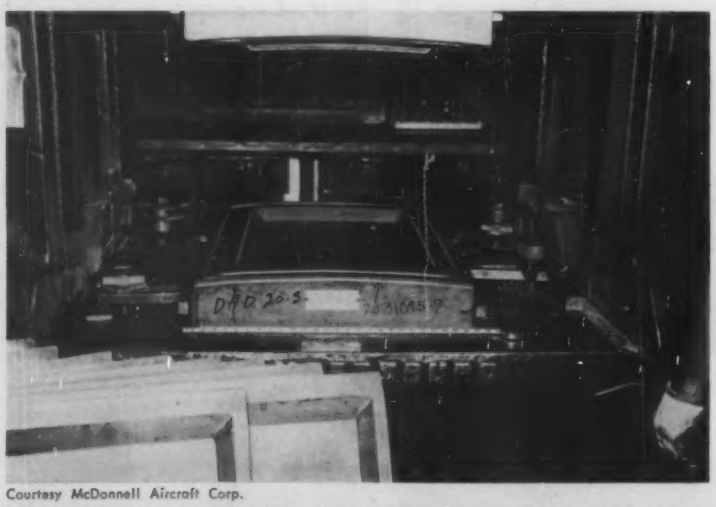
From this point on in the operation there are several different methods recommended for completing the die. Foamed phenolic, cast phenolic, honeycomb structures, and other means are used to complete the "back-up" for the plastic shell. Ren-ite Plastics recommends a room-temperature cure casting resin which is poured onto the cured epoxy shell (see Fig. 20). Sufficient backing-up material is applied so that the shell is rigidly supported. After the casting has hardened and the heat dissipated, the build-up is removed and a balance line scribed on the outside of the die, coordinated with the base of the model. A surface plate is then coated with a parting agent and a quantity of plastic paste is poured on its surface. The die is set into this paste and adjusted so that the balance lines of the die are parallel with the surface plate. This die is then used in place of the model for constructing the remaining mating parts such as the punch and binder ring. All steps as previously described are followed for the production of these parts.

Evaluating Dies

A special drop hammer die was produced by Ren-ite for evaluation purposes. This die (see Fig. 21) has been tested in drop hammers at over thirteen different aircraft companies and metal working industries.

Approximately 3500 parts have been stamped out with this die. The following different metals have been successfully handled: all grades of aluminum up to 0.064 in.; some titanium, 0.035 in. thick, covered with a 0.031-in. rubber blanket and formed cold; soft steel sheet, 0.064 in. thick; magnesium, 0.041 in. thick in the following conditions: cold, heated to 500° F. before forming, and heated to 600° F.; and stainless steel, 1/4 hard, 0.063 in. thick, 1/4 hard, 0.051 in. thick, 1/2 hard, 0.041 in. thick, and annealed sheet 0.063 in. thick.

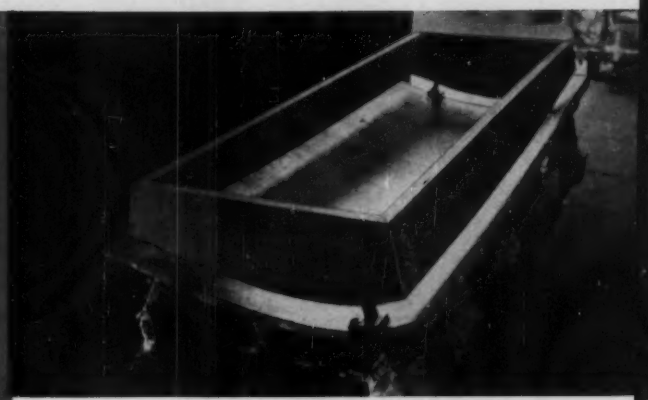
At the completion of these tests, it was found that there were no failures in the die surface while forming aluminum. Some small degree of breaking down in the bead section occurred in the stainless steel runs, but engineers indicated



Courtesy McDonnell Aircraft Corp.

Epoxy resin-fibrous glass laminate drop hammer die, economically made by one technique described in this article, eliminates the need for costly die grinding

GRUMMAN METHOD FOR MAKING STRETCH DIES



Photos courtesy Grumman Aircraft Engineering Corp.

Fig. 22—Plywood framework for the core of a phenolic stretch die is mounted on a plaster model cast from a master mockup

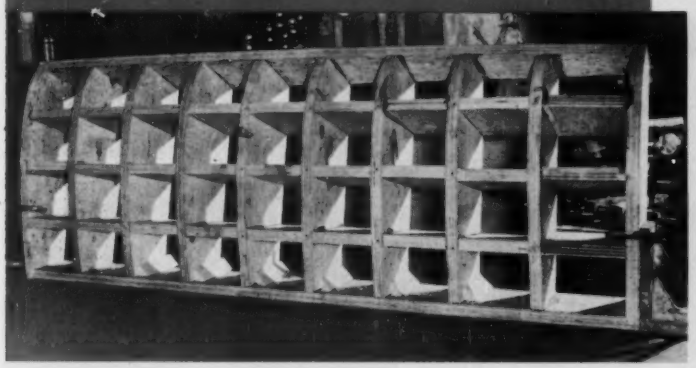


Fig. 23—Bulkheads and ribs, which are designed to reinforce the phenolic die, are then mounted in place within the plywood framework of the stretch die core

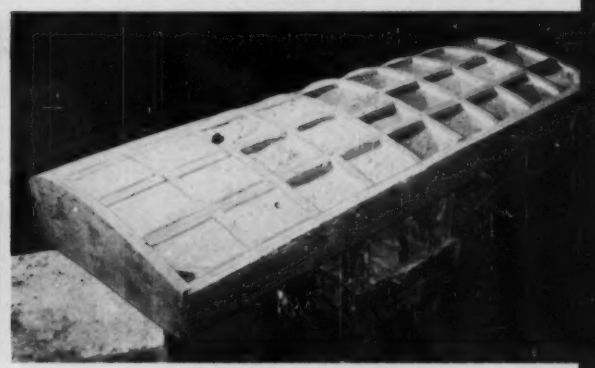


Fig. 24—Wire mesh is next positioned in each of the openings of the core and plaster is added on top of the mesh

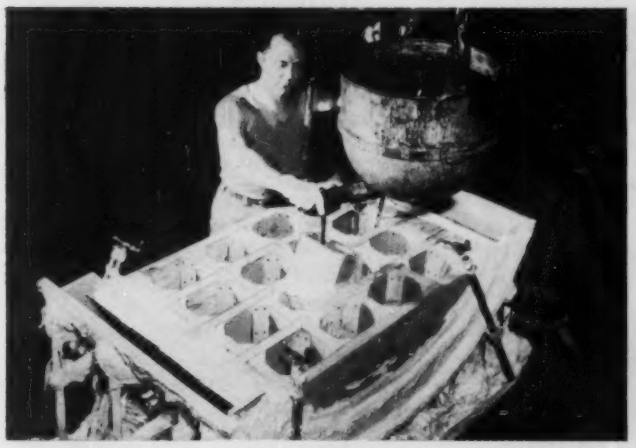


Fig. 25—After the core has been inverted, the specially formulated liquid cast phenolic resin is poured into an opening in the core

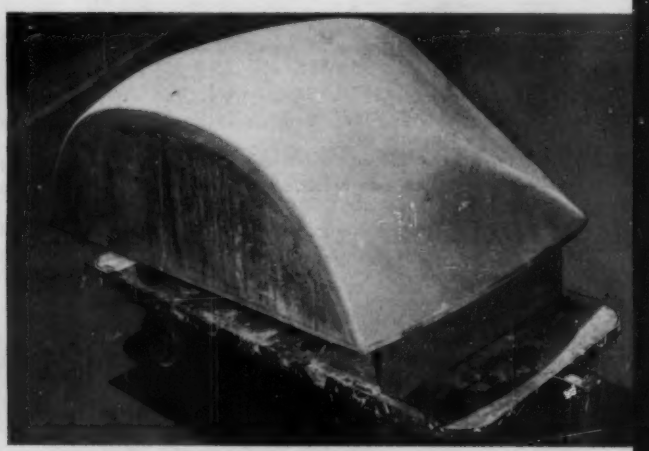


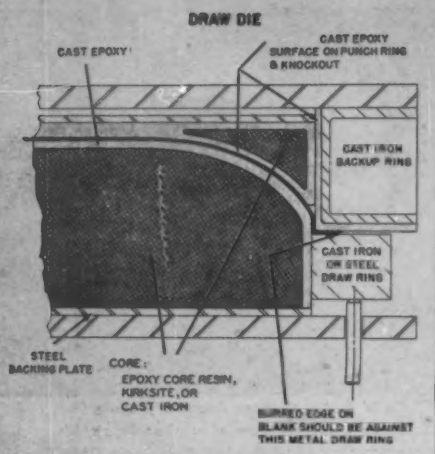
Fig. 26—The entire assembly is then oven-cured, the bulkheading is removed, and the completed die is ready for mounting in press

that this was primarily because of the following reasons: 1) failure to lubricate the die; 2) re-striking a ½ hard stainless part in an attempt to remove wrinkles; and 3) not maintaining exact metal clearance. It was a simple matter, however, to repair bead sections which had broken down.

These same methods and materials were used by McDonnell Aircraft Corp., to produce drop hammer dies for making sheet metal parts for the firm's F3H Demon single jet fighter and the F101 Voodoo twin jet fighter built for the Armed Forces.

Another processing technique is offered by Grumman Aircraft Engineering Corp. This company uses cast phenolics for all of the stretch dies on which sheet aluminum is formed into the various components of numerous types of fighter planes. There are many different methods of casting a phenolic stretch die. The technique developed at Grumman, however, is the result of many

PLASTICS DIES PRODUCED BY KISH METHOD



Illustrations courtesy Kish Resin, Inc.

Fig. 27—Cross section of die with epoxy core backing and die surface

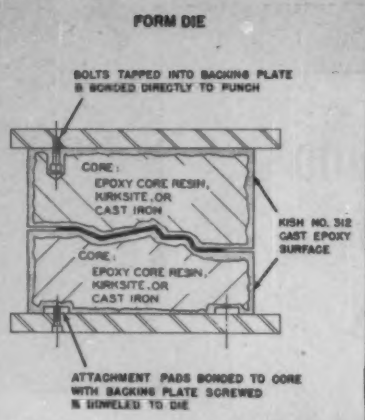


Fig. 28—Epoxy die can have either cast epoxy, Kirksite, or iron core

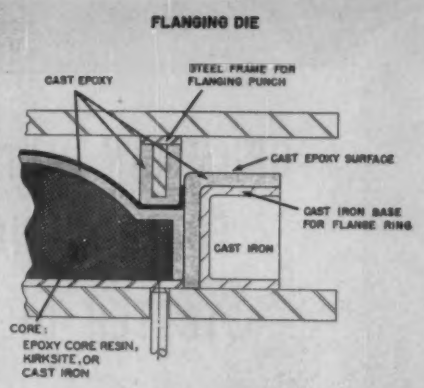


Fig. 29—Cast epoxy surface of flanging die can withstand continuous wear

Photos courtesy Kish Resin, Inc.

Fig. 30—Forming die with reinforcing inserts was built in less than ½ the time required for a metal die

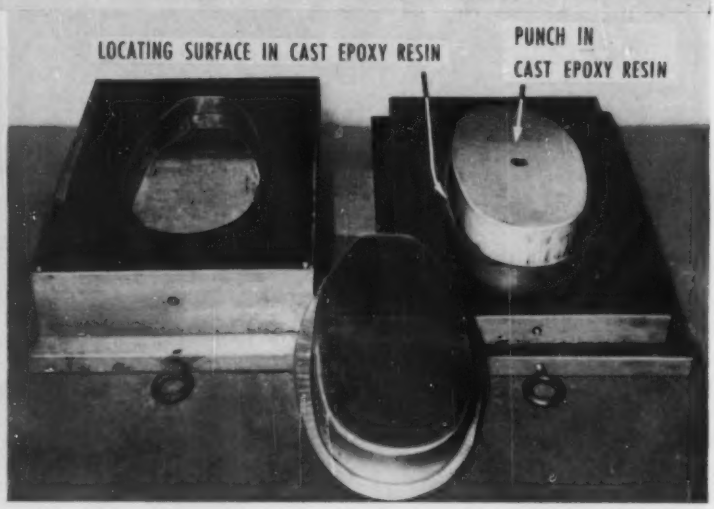
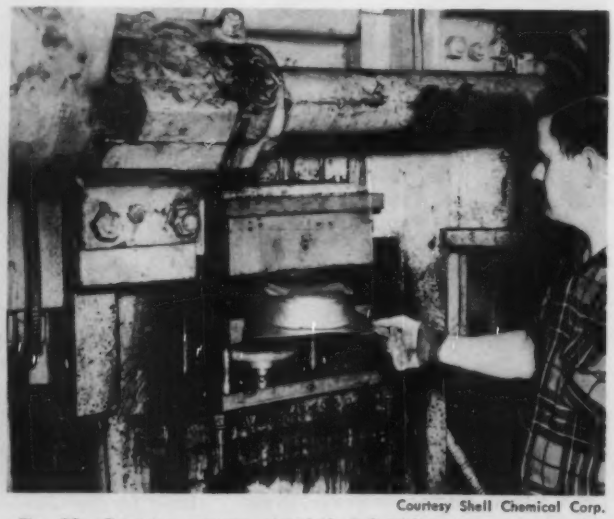


Fig. 31—Cast epoxy draw die for making half of an outboard motor housing was delivered to manufacturer only three weeks after receipt of drawings

Courtesy Kish Resin, Inc.

Fig. 32—Epoxy dies cost approximately 1/3 as much as comparable metal dies and have already successfully turned out over 15,000 pieces



Courtesy Shell Chemical Corp.

Fig. 33—Operator removes stamped outboard motor upper housing from press in which the cast epoxy draw die is in service

years of experimental work and has now been finalized as a standard technique for the company's various jobs.

Stretch Die Production

The first step in making the die is the production of the plaster cast from a master mockup. As shown in Fig. 22, the plywood framework of the die core is mounted on the plaster cast. With the frame located in position, the limits or actual dimensions of the ribs and bulkheads are determined. Figure 23 shows the core of the die with the bulkheads and ribs mounted in place.

In order to conserve or limit the amount of casting resin required to complete the die, wire mesh is positioned in each of the openings of the core and plaster is added on top of the mesh until it almost fills the space between the mesh and the surface of the core. (See Fig. 24.) Triangular pouring vents are located at two corners of the core, and in the center is a rectangular pouring gate with wire mesh tacked across the surface of the core.

The core is next inverted and laid in position somewhat above the surface of the plaster cast. The space between the surface of the cast and the undersurface of the core dictates the thickness of the phenolic skin or die surface. After the necessary bulkheading has been added and sealed in with plaster, the specially formulated, liquid cast phenolic resin is poured into a funnel connected to the rectangular opening in the core. (See Fig. 25.) Pouring will continue until the resin rises in the vent openings. Although the stretch die shown in Fig. 25 is not the same one as that in Figs. 22 to 24, it clearly illustrates the technique described. Figure 26 shows the finished stretch die. After pouring, the entire assembly is placed in an oven for approximately 24 hr. for curing, after which the bulkheading is removed and the die, as shown in Fig. 26, is ready to be mounted in the stretch press.

Grumman reports that the construction, through the pouring stage, of an average size cast phenolic stretch die (following the construction methods shown in the accompanying photographs) takes about 80 hours. They state that the same die made of Kirksite, to the casting stage, would take about 60 hours. After the dies are poured or cast, however, there is a considerable difference in grinding or fitting time between the casting of Kirksite dies before they are ready for actual production use and the casting of the phenolic tool.

The negligible amount of shrinkage of the phenolic permits production use of the die five days after the pouring operation, whereas the Kirksite die, which shrinks considerably, requires about 11 days of grinding after the pouring operation before it is ready for production. The average size cast phenolic stretch die is in production use about six days before its equivalent die, if made in Kirksite, would be ready. Furthermore, the total cost of a cast phenolic stretch die is approximately 66⅔% that of an equivalent Kirksite die. Another advantage is that the cast phenolic dies of hollow core construction have only a weight of approximately one-quarter of that of the metal die.

Still a third technique is recommended by Kish Resin, Lansing,

(*To page* 218)

Photos courtesy The Marblette Corp.

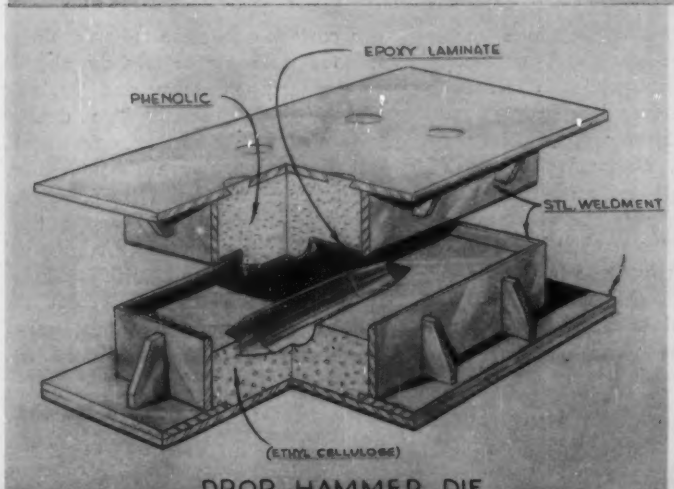
Aluminum gas tank is one of several airplane parts formed on epoxy dies

Deeply-ridged tank is removed from press where it has been hydro-formed

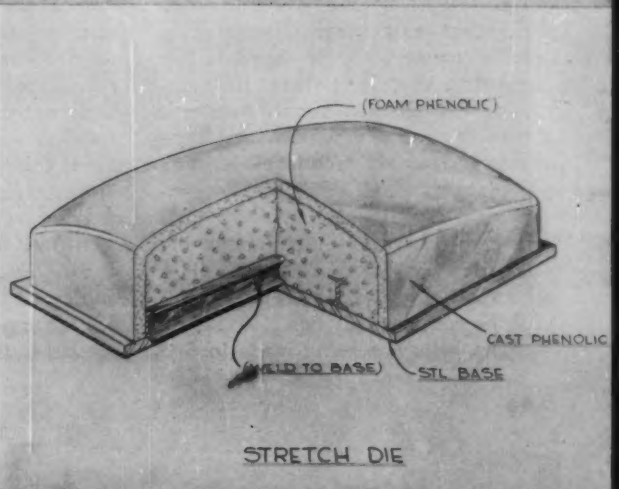
Ethyl cellulose cavity, phenolic core, and epoxy laminate working face of drop hammer die are all contained in steel weldments

Stretch die with metal base, foam phenolic core, and phenolic working face can be produced in a minimum of manhours

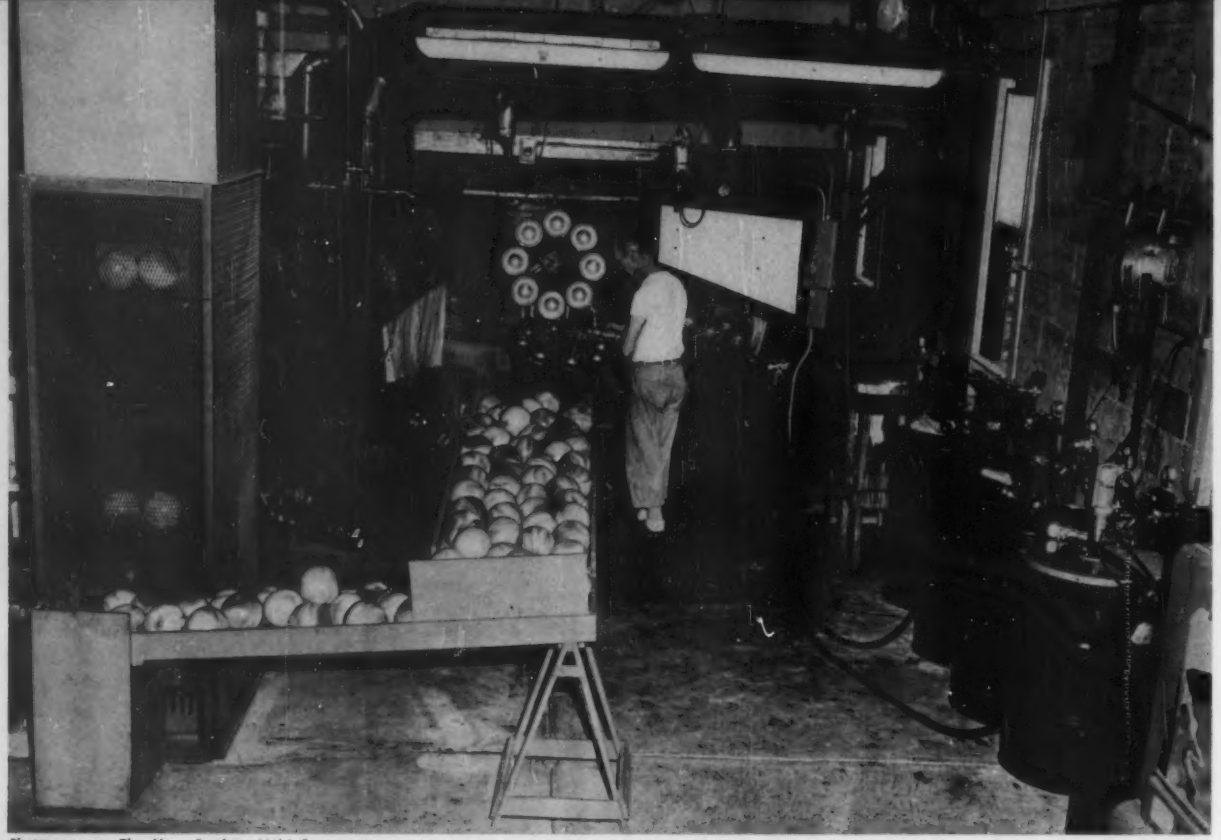
Photos courtesy Rezolin, Inc.



DROP HAMMER DIE



STRETCH DIE



Photos courtesy The Akron Presform Mold Co.

Over-all view of a vinyl ball production unit. Operator is filling set of molds with plastisol from drums at right; molded balls move off at left

MORE BOUNCE

Air-filled, hollow molded plastisol play balls perform better, keep their liveliness longer, do not lose their color

MOLDED of vinyl plastisol by means of a high-speed rotational casting process, rugged, colorful play balls with exceptional bouncing characteristics are rolling by the thousands off the production lines of the National Plastex Div. of National Latex Products Co., Ashland, Ohio. The plastic balls have so many advantages over conventional rubber play balls that they have scored a hit with toy buyers as well as with the younger element.

Although balls of this type have been previously made in Europe (by a different process), the new National Latex balls are said to be the first cast vinyl plastisol play balls commercially produced in this country. In order to meet the company's production requirements, it was necessary to design and construct special rotational casting equipment which automatically carries the multi-cavity molds through a heated oven section, revolving them continuously so that the plastisol is gelled against the inner wall of the spherical cavities.

The balls are being made in five standard sizes, ranging in diameter from 2½ to 6½ in., in 2- or 3-color marbleized finishes. In addition to their outstanding bouncing characteristics and their permanent brilliant colors, National's Blue Bird inflated vinyl balls are non-toxic, sanitary, washable, and very durable.

In contrast to rubber balls, which are customarily made in two halves and cured together with a small gas pill enclosed to build up internal pressure, the vinyl plastisol balls are cast as one-piece spheres, then inflated with air to slightly above atmospheric pressure and sealed. Rubber balls usually "go dead" within a few months as a result of diffusion of pressure through the walls. The vinyl balls, by contrast, being relatively impervious to the passage of air, maintain their lively bounce almost indefinitely. This feature is extremely important to the toy buyer, who can thus purchase supplies of balls months in

advance without fear of having them lose pressure and play value before being sold.

Color permanence of the vinyl plastisol balls means that they can be subjected to hard service and washed repeatedly without losing their original glossy sparkle. The variegated pattern used in the multi-color balls is produced by the blending of different color plastisols in the molds while they are rotating in the heated oven. Rubber balls are conventionally made in a solid color, then finished with surface colors which flake and crack off in use.

Basic Formulation

Manufacture of the plastic balls is under the direction of Lloyd Whittington, plastics division manager, who developed the production processes for National Latex and worked with the machine manufacturer in the design of the casting equipment.

The first step in the production of the balls begins with the formulation of the plastisol to the desired specifications. This is done by an outside supplier who then ships the liquid material to Ashland in 55-gal. drums. No further mixing or formulating is required in the plant. Considerable experimental work was required to produce a plastisol formulation which would yield balls that would bounce well, yet would not attack varnished surfaces.

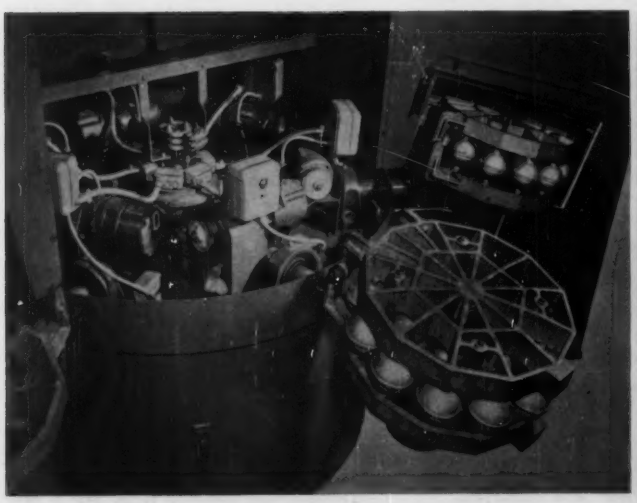
Drums containing the various colored plastisols are lined up in an area adjacent to one of the rotational casting ovens. On top of each drum is an Alemite pump of the type customarily used by automotive service stations to withdraw lubricants from the containers. Rubber hose lines connect one or more of the drums with a feed nozzle which meters out an accurate charge of the liquid plastisol each time that the push-button control is pressed down. The lines may be so arranged that only a single color or a combination of two or three colors is fed from the nozzle.

The molds used in production of the vinyl balls are made of die cast aluminum and consist of individual hemispheres paired off to form each ball. The cups are individually bolted to the supporting upper and lower frames so that each may be removed and replaced if necessary. The cast aluminum frames, or "spiders," to which the hemispheres are fastened are hinged together at the back so they may be swung open like a book. The total diameter of each complete mold is approximately 25 inches. When the molds are in the open position for loading resin in the cavities or removing the finished balls after curing, casters mounted on the top half of the molds allow them to move without interference across the front of the oven.

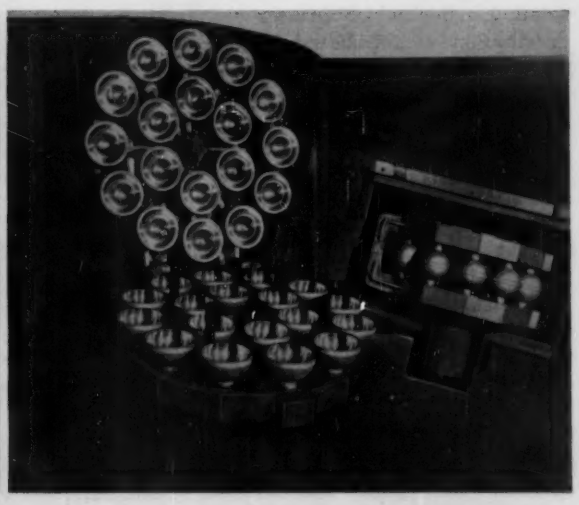
Radial Arms

The rotational casting machine consists basically of an enclosed oven section and a series of six radial arms which support the molds during the heating and fusing process. The unit is so designed that the complete group of molds revolves about a central shaft as they are carried through the oven section. The oven itself is electrically heated

IN VINYL BALLS



Open view of casting machine. Microswitch actuated electric motors, one for each set of molds, rotate molds as they move through fusing oven



Upper and lower sections of 18-cavity mold for smaller balls are hinged at back to facilitate plastisol filling and ball removal

Photos courtesy National Latex Products Co.

1 Mold cavities are filled with liquid plastisol as first step in molding vinyl balls. Dispensing nozzle has metering control

2 After cavities are filled, the two halves of the mold are sealed. A power-driven torque wrench is used to drive four lock-bolts home

by means of elements utilizing 120 kw. and is equipped with forced air circulation. Mounted at the end of each of the supporting arms, the molds are not in a horizontal position, but tipped slightly outward.

The mold support arms are equipped with separate drive shafts and independent electric motors which cause each set of molds to revolve as they move through the oven section. Under normal operating conditions, each set of molds requires approximately 18 min. to pass through the complete cycle. At the same time, each group of molds rotates independently at from 10 to 16 revolutions per minute. It is this rotating action which insures even distribution of the liquid plastisol material within the mold cavities as it gels and fuses into the finished product.

Filling Operation

The sequence of operations in the production of the plastic balls is as follows:

First, the plastisol is metered from the supply drums into the cavities of one of the open molds, which has previously been blown out with an air hose to eliminate all traces of moisture. In performing this filling operation, the operator places a metal plate over the mold cavities. This plate has circular openings corresponding to the location of the molds and assists the operator in directing the plastisol accurately into the molds.

Next, the metal plate is removed and the top half of the mold closed down over the bottom half and secured in place by means of four captive bolts which pass through the upper half of the mold and engage tapped openings in the lower spider. This is easily accomplished without risking stripped threads by using a powered torque wrench.

As the closed mold moves through a curtained opening in the oven section, it actuates a limit switch which starts the spider and set of molds rotating. Rotation continues until the mold has passed through the entire oven chamber and contacted another limit switch which stops the action. Air temperature within the oven is automatically maintained in a range from 460° to 540° F., producing a temperature within the aluminum cavities of about 350° F. At these temperatures, the plastisol passes through the gelation stage and then fuses to its final resilient form.

After emerging from the oven, the molds pass through a chamber where they are showered with cold water for about one minute. The molds are then opened by loosening the four bolts with a power wrench and lifting back the top half of the mold and the balls are removed.

Since the machine carries six sets of molds simultaneously and the average complete cycle is around 18 min., a new group of balls is being removed from the molds and the molds charged with fresh plastisol about every three minutes. One operator is able to handle the complete output of one machine, since all phases of the process except the loading of the cavities and removal of the finished balls are accomplished automatically. With two recently installed rotational casting units in full operation, the plant will be able to turn out up to 40 thousand of the balls daily, depending upon the sizes being run.

Inflation

Upon being removed from the mold, the balls are placed in a sloping chute out of which they move by gravity to an automatic elevator —a vertical conveyor which picks up the balls, several at a time, and carries them to the second floor level. Here they roll down a ramp and tumble into a series of cage-like storage bins in which they remain for several hours before moving on to the final inflation and packaging operations. Movable baffles along the overhead ramp are used to direct the balls into the desired storage compartments and keep them separated according to size and color.

Beside the storage bins are a series of movable tables on which the vinyl balls are inflated and sealed.

3 After passing through cold-water shower at end of fusing cycle, mold emerges from casting unit, is opened, and balls removed

4 In final operation, vinyl balls are inflated to slightly more than atmospheric pressure through hypodermic needle, then sealed

These tables may be easily transferred into position beside any storage bin. Intermittent electrical and air line connections are available so that each operator can "plug in" conveniently at any point in the line. The bottom of each bin is sloped outward, permitting the balls to roll into a compartment beside the table when the plywood gate is raised. Operators working at these tables insert a hypodermic needle connected to an air line into each ball, inflating it to slightly more than atmospheric pressure for added "bounce," and then seal the small puncture with an electrically heated soldering iron.

Packaging

At the same time that the balls are being readied for packaging, they are closely checked for any surface imperfections, leakage, etc. At this point, any small amount of flash which may be present along the mold parting line is trimmed off. However, very little flashing is experienced during the casting operation and relatively little trimming is required. Before being placed in the shipping boxes, each ball is heat sealed in a transparent acetate wrapper which protects the ball against soilage. The company includes corrugated and wire display racks with each shipment.

According to Harry R. Gill, Jr., president of National Latex, the company is also bringing out a new line of hollow vinyl toys, such as turtles, fish, seals, etc., which will supplement the play balls. These toys will be produced by rotational casting on the same type of equipment and will be designed to take advantage of the same outstanding physical properties of vinyl plastisol materials which are proving responsible for the success of the play balls.

Brightly colored vinyl balls are effectively merchandised in retail outlets through use of sales-enticing display

CREDITS: Vinyl plastisols formulated by Reslac Chemicals, Inc., Chicago, Ill., using vinyl resins supplied by Bakelite Co. and B. F. Goodrich Chemical Co. Rotational casting equipment and ovens by The Akron Presform Mold Co., Cuyahoga Falls, Ohio. Alemite pumps for injecting plastisol into molds through nozzle, supplied by Stewart-Warner Corp., Chicago, Ill. Ball elevator from C. M. Wilkinson Co., Akron, Ohio

Attractive acrylic housing for photocopier, produced by snap-back vacuum forming technique, has blemish-free exterior

Photos courtesy Cormac Industries, Inc.

Top half (right) of the compact, self-contained photocopier is designed to house a complete developing unit. With the acrylic cover in place, the streamlined portable machine measures 10 by 19 by 10 in., weighs only 19½ pounds

PROTOTYPE BECOMES PRODUCT

Pilot models of new photocopiers were fabricated from acrylic for a show; satisfactory results led to speeded up quantity production by same method

IT HAPPENS to every manufacturer at least once in a lifetime. He has an engineering concept and a polished design for a grand, new product; he has six weeks in which to produce enough units for a national show and for distributors—and he has too little time for tooling.

In the case of Cormac Industries, Inc., New York, N. Y., which was faced with just such a problem in the introduction of its new photocopier, the Cormac Compact, a wise selection and use of plastics materials provided the perfect solution.

Simple Operation

The Cormac photocopier is a practical office machine which can produce copies of literally anything, from correspondence to photographs, on sensitized paper.

When in use, the original to be copied is sandwiched between positive and negative treated paper sheets. The three sheets together are then exposed to light. After exposure, the original is slipped out from between the positive and negative sheets and the transfer from the exposed negative to the positive is accomplished by running the two sheets together through the developing unit in the top half of the self-contained Compact model.

In 15 sec., the negative can be peeled away and a dry, black-on-white facsimile of the original remains on the positive copy.

The new photocopier, created by Frank Samet, an electro-mechanical engineer, was nearing the end of its prototype testing stage when Cormac's management decided that the advantage of launching the new product at a show six weeks away warranted a herculean effort to meet the deadline.

Accordingly, Cormac commissioned Steiner Plastics Mfg. Co., Glen Cove, N. Y., to build a prototype out of gray, white, and black acrylic. Submitted to management, the hand-made model met with hearty approval. The decision was therefore made to fabricate by vacuum and drape forming a sufficient number of models for the show and for dealers.

As illustrated by the photographs on these pages, the designers of the photocopier relied heavily upon plastics materials for the construction of the unit. Plastics are always a natural selection as material for photocopying equipment, since they

are resistant to the chemicals that are used, attractive in finish, light in weight, and easily cleaned.

In the case of the Cormac® Compact, however, the use of plastics was even more important by virtue of the fact that the light from the single light source which serves the sensitizing lower section of the unit is carried along a small acrylic rod to the pilot light indicator.

Plastics Components

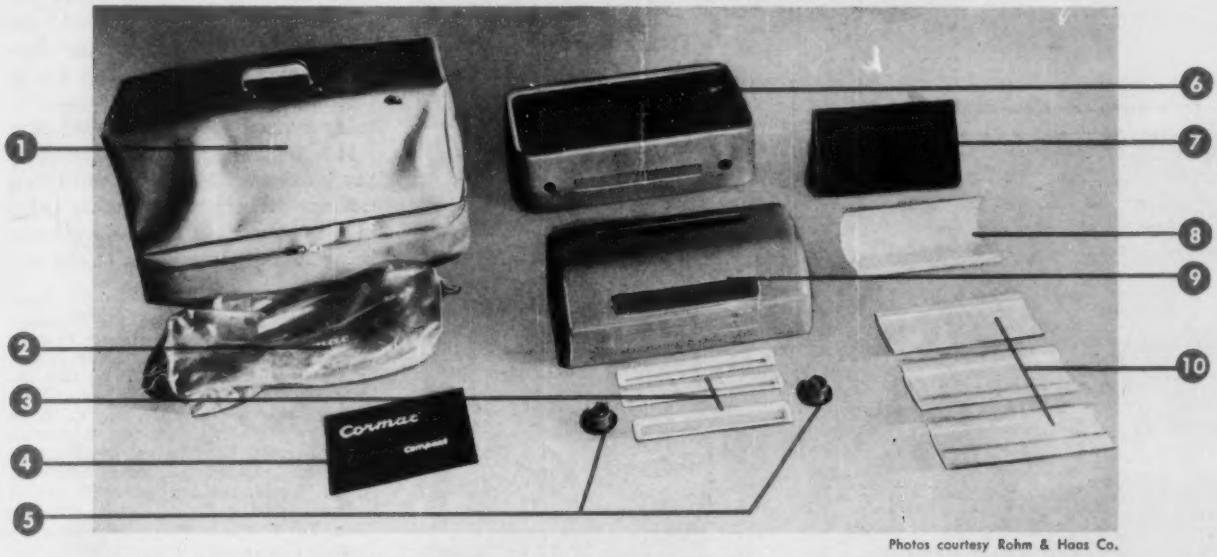
As a result of the extensive use of plastics, Cormac was able to produce a portable, desk-top unit that is claimed to be one of the smallest and lightest on the market. The entire machine measures 10 by 19 by 10 in. and weighs only 19½ pounds.

The base housing of the Cormac photocopier is simply drawn from gray acrylic sheet into a vacuum pot and released against a cast phenolic male die to effect a blemish-free exterior. The removable top housing is made in the same manner, but with a wooden male die for purposes of economy. Two slot frames in the top section and one in the base housing are made from white acrylic sheet on wooden fixtures with hold-down rings and clamps.

In the interior of the photocopier, the most important components are the solution tray or tank which is drawn from black acrylic sheet and the three serrated, curved baffles or guide plates which direct the paper through the tank. These plates are made from white acrylic sheet, vacuum drawn, and snapped back against a cast phenolic mold. Two guide plates are formed simultaneously and cut in two after forming.

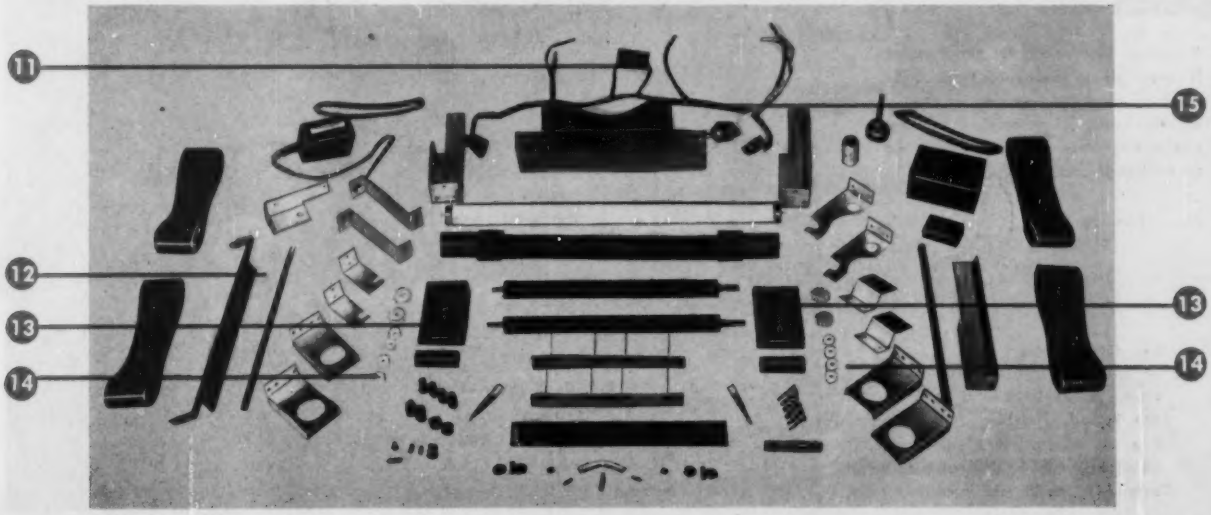
The internal mechanism of the machine includes black acrylic bearing plates, nylon gears, nylon and vinyl grommets, vinyl-covered wire harnesses assembled for the electrical circuit, and an acrylic bearing pad to which the stainless steel stud for the roller mechanism is attached.

On the outside of the machine are



Photos courtesy Rohm & Haas Co.

Both the exterior and interior of the new machine make extensive use of plastics. Components include (above): 1) vinyl-covered carrying case with butyrate handle; 2) polyethylene cover; 3) acrylic frames for paper feed slots; 4) molded styrene name plate; 5) butyrate control knobs; 6) acrylic base housing; 7) acrylic developing tank; 8) acrylic tank guide; 9) acrylic top housing; 10) acrylic tank guides; and (below) 11) molded phenolic electrical terminal block; 12) vinyl feed roller; 13) acrylic bearing block; 14) nylon gears and bearings; and 15) vinyl-covered electrical harness



Two plates for guiding paper through developing tank are formed by vacuum drawing a sheet of acrylic and letting it snap back against a cast phenolic mold. The formed piece is then cut in half to separate the two plates

Photos courtesy Rohm & Haas Co.

Finishing line for acrylic top housing is installed in fabricator's plant in front of production set-up for acrylic aircraft parts. After finished housing has met requirements, it is passed on to an initial assembly line

In another phase of finishing operations, plates (left) and tanks (right) are buffed. Finishing and assembly line in fabricator's plant is coordinated with mechanical and electrical assembly line in manufacturer's plant

two butyrate control knobs, acetate dials, molded styrene escutcheons, and the white frames described above for the slots. The frames are glued into place by the plastics fabricator.

The pilot models which were produced as described above were accorded an excellent reception in the market. Cormac management, completely satisfied with the response to the pilot model, decided to continue manufacturing commercial machines using the same basic production tooling as on the pilot job. A finishing and assembly line was set up at the Steiner plant and coordinated with the mechanical and electrical assembly line in the Cormac plant.

In the final preparation of the photocopier for the market, the manufacturer went all out for plastics by encasing each unit in a protective polyethylene slipcover and by using a vinyl-covered carrying case.

It is significant to note that, coming into the field nine months ago, Cormac already stands third today in the industry in numbers of units being sold—thanks again to plastics!

CREDITS: Plexiglas cast acrylic sheet supplied by Rohm & Haas Co., Philadelphia, Pa. Fabrication by Steiner Plastics Mfg. Co., Inc., Glen Cove, Long Island. Cast phenolic tool materials by Rezolin, Inc., Los Angeles, Calif., and Marblette Corp., Long Island City, N. Y. Tools made by Steiner. Gears and grommets molded from Du Pont's Zytel nylon by Molding Specialists, Inc., Yonkers, N. Y. Knobs molded from Tenite II butyrate by the National Co., Walden, Mass. Polyethylene and vinyl covers by Plastic Fabricators, Inc., New Haven, Conn.

NEWS AND VIEWS OF PLASTICS PROGRESS

STOKES plastics review

VOL. 3

NO. 3

1954

PUBLISHED BY F. J. STOKES MACHINE COMPANY, PHILADELPHIA 20, PA.

Stokes Truly Automatic Injection Molding Machines Reduce Labor and Cut Costs for Sylvania

The big plastics plant of Sylvania Electric Products Co., Warren, Pa., has six Stokes 4-ounce truly automatic injection molding machines, some of them in use for three years.

Butyrate, methacrylate, nylon, polystyrene and polyethylene have been used by Sylvania in more than 200 molds, with only a single operator for all six machines. Compared with semi-automatic machines, the Stokes machines have shown exceptionally high output of uniform, de-gated, finished pieces. Good mold design—a prerequisite for successful automatic operation—and consistent cycles, have further enhanced production by reducing rejects to a minimum.

Sylvania makes a vast number of plastic radio parts, wiring and lighting fixtures, bottle caps, knobs, dials and other parts in quantities up to 2,000,000 per day; largely for use in Sylvania's products, although they have also a large custom molding business.

Stokes automatic compression presses have also proved an important factor in building Sylvania's big plastics operation. Stokes Models 200-D3, 741, 800 and closure presses—all fully automatic—total 31 in number and are handled by two operators plus a set-up man. The two molders' duties are limited to occasional inspection and removal of finished parts. Stock handlers take care of loading the hoppers but are largely concerned with tumbling and finishing. A fully illustrated descriptive bulletin on the new Stokes injection molding machine will be sent on request.

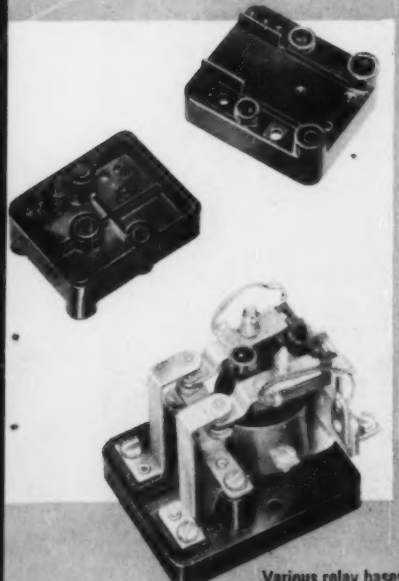
Six Model 700 Stokes automatic injection molding machines in foreground at Sylvania Electric Products Co., Warren, Pa. They are producing finished de-gated pieces including radio and TV knobs, lighting fixture parts, can spouts and camera parts. They run 24 hours a day and require the attention of only one man per shift.

Potter & Brumfield Instrumental In Forming Relay Standardization Board

The confusion between relay specifications of government, commercial users and manufacturers of relays has pointed the need for new standards to assure efficient procurement of military electronic equipment.

Potter & Brumfield of Princeton, Indiana, some of whose executives have been active participants in symposiums on relay problems, is one of the country's leading manufacturers of these essential electric and electronic elements. Products of Potter & Brumfield's plants include contactors, shaded pole motors, electro-mechanical assemblies and more than 15,000 types and sizes of relays.

Thousands of precision-molded parts are used in making these relays. Many of these are made on a Stokes Model 741 fully automatic press, recently installed at Potter & Brumfield's Plant No. 3. They are made in 3- or 4-cavity molds on 2½- to 4-minute cycles. The 741 press is an addition to an older Stokes Model 235 automatic press which has been in use for several years. Since only ten percent of a man's time is required to operate a Stokes automatic press, the addition of the new press requires no additional personnel.



Various relay bases made on Stokes Model 741 press at Potter & Brumfield molding plant; also picture of complete double-pole, double-throw heavy duty power relay made by this company.

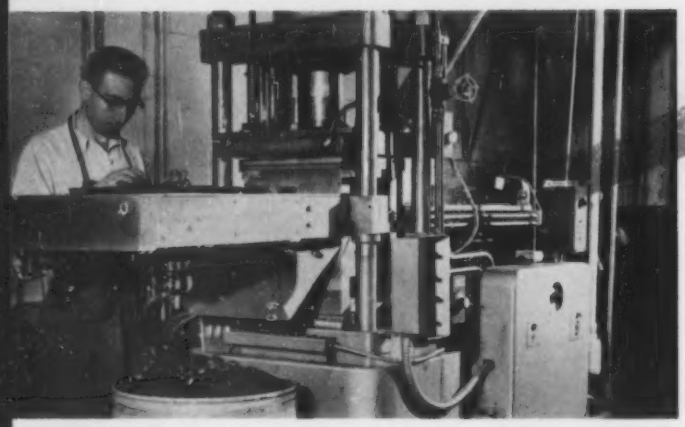
STOKES

With an Alcamatic Cooker You Can Live Without a Stove and Like It!

The Alcamatic Electric-Oven Cooker cooks, fries, roasts, bakes, stews, steams and serves. It does everything but heat the apartment, but what do you expect for $49.95?

Alcamatic products are made by Eastern Metal Products Co. of Tuckahoe, N.Y. They come complete with heating unit, thermostatic controls, and plastic handles, knobs and other parts made on Stokes Model 741 fully automatic presses. The versatility of these presses is indicated by the range of five products—cover knobs, legs, handles, thermostat and drain valve knobs—made in molds with six to 25 cavities at rates of 3000 to 16,000 per 24-hour day.

Typical Alcamatic unit for deep frying and other cooking functions.



Stokes Model 741 fully automatic 50-ton molding press, one of several used by Eastern Metal Products Co.

The economy of fully automatic molding may be estimated from the manufacturer's experience in reducing the cost of molded parts by two-thirds since the installation of the Stokes 741's.

Alcamatic products come in numerous sizes and shapes, and varying versatility. Eastern Metal Products also operates a permanent-mold and die-cast foundry which has a remarkable record of fine quality production for military and civilian purposes.

A Philadelphia Story

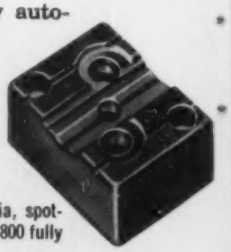
There's one thing about installing a Stokes molding press in a plant at 1100 Adams Avenue in Philadelphia: if anything goes wrong with it you're practically around the corner from the Stokes plant!

Fortunately for Gessner Manufacturing Co.—and for Stokes—nothing has gone wrong. William Gessner and his brother Edward, partners in the firm, say that the Stokes 15-ton Model 800 is "the best automatic molding press" they've ever seen, a heartening exception to the theory that a prophet is not without honor save in his own country. Since a Stokes automatic press requires only a tenth of a man's time the installation of one press calls for no increase in total labor cost.

William Gessner, Gessner Manufacturing Co. of Philadelphia, spot-checks electronic insulators as they come from Stokes Model 800 fully automatic molding press.

The brothers Gessner are running a fairly new custom molding business but have already built up a gratifying volume of business in the manufacture of thermosetting plastic parts largely for use as electrical and electronic connections. Typical of these is a lightning arrester shown in an adjacent picture. This is made in a 6-cavity mold on a 70-second cycle at a rate of approximately 320 pieces per hour.

A catalog describing the Model 800 fully automatic press is available on request.



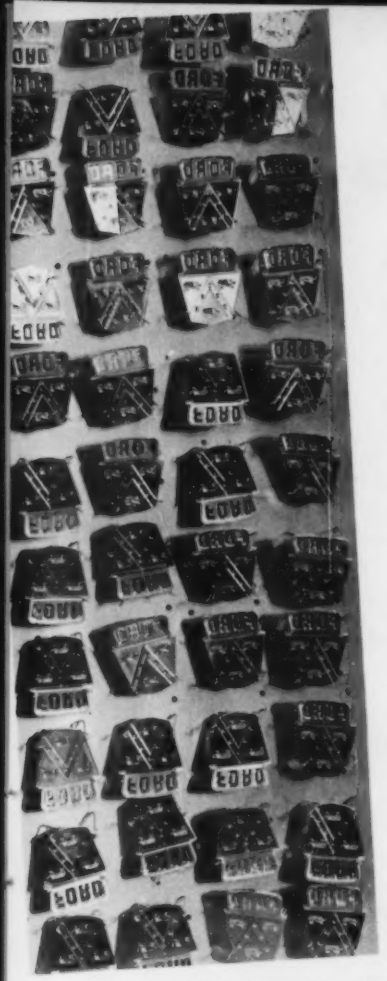
Lightning arrester made of general-purpose phenolic by Gessner Manufacturing Co. on Stokes Model 800 fully automatic molding press.

Hoosier Cardinal of the Hoosier State Pioneered Vacuum Metallizing Process

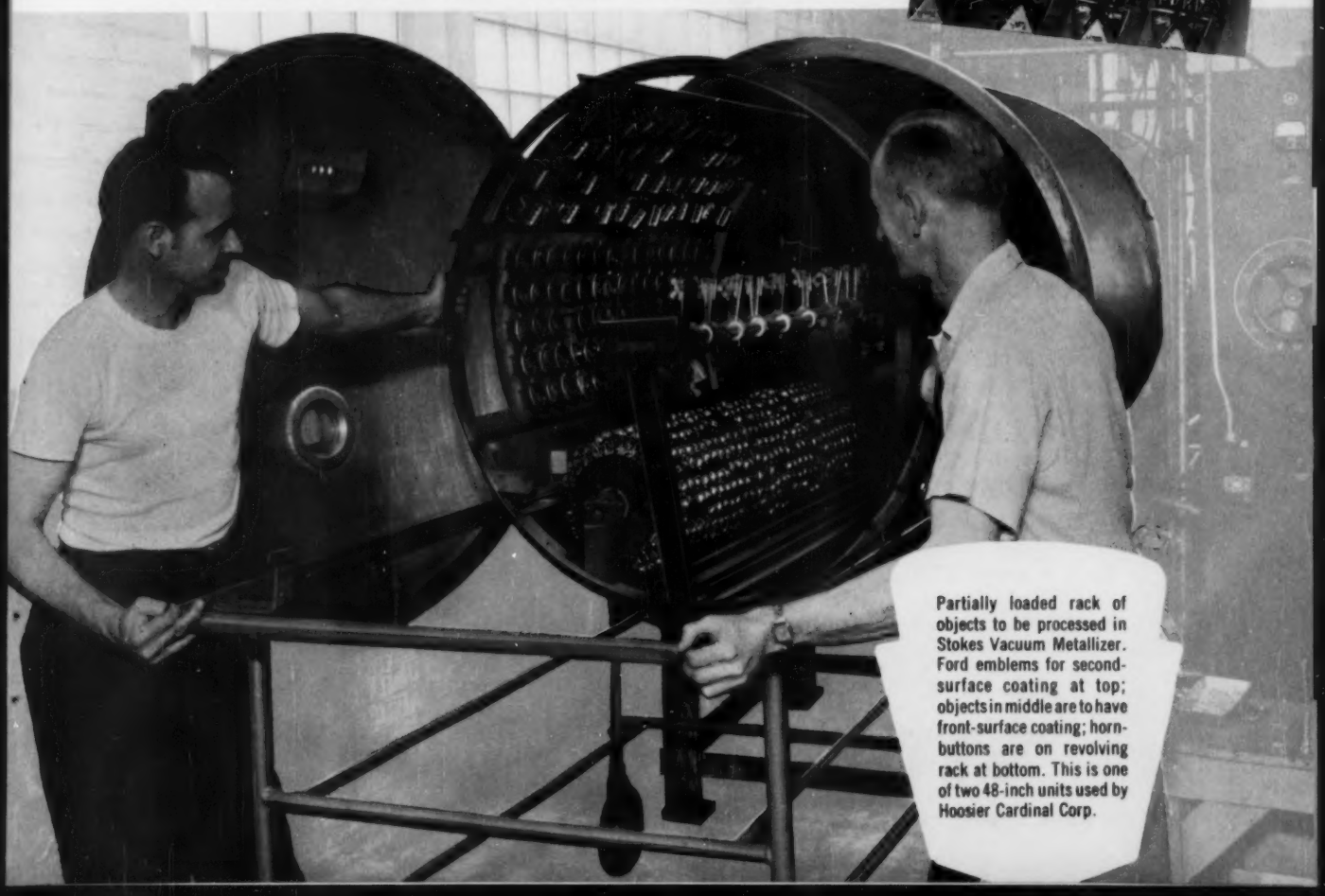
Hoosier Cardinal Corp. of Evansville, Ind., was one of the first companies to utilize vacuum metallizing commercially. Their own vacuum metallizing unit—now augmented by two Stokes 48-inch units—was used for some years during which they are credited with devising the "See-Deep" or second-surface coating process. The Cardinal Division of Hoosier Cardinal also does front-surface metallizing on plastics to give the effect of bright chrome-plated die castings.

In second-surface coating a transparent glass or plastic object is vacuum metallized on the under surface, then lacquered or painted to protect the metal coating. The brilliant metal coating, with or without design features, is seen in use from the front side through the transparent medium and gives a three-dimensional effect to the pattern. The process enjoys growing use in nameplates, emblems and decorations for home appliances and automobiles. It is largely with manufacturers in these fields that Hoosier Cardinal has built its big vacuum metallizing business.

There is available a strikingly handsome new Stokes brochure on vacuum metallizing. Copy will be sent on request.



Ford emblems shown at left (the back before metallizing) and at right (the front after metallizing)



Partially loaded rack of objects to be processed in Stokes Vacuum Metallizer. Ford emblems for second-surface coating at top; objects in middle are to have front-surface coating; horn-buttons are on revolving rack at bottom. This is one of two 48-inch units used by Hoosier Cardinal Corp.

Precision Motors Require Precision Test Equipment

An automobile is, without doubt, the most complex device ever made for common use. Indeed, it is so complex that even experienced service men can no longer rely on the sense of touch or hearing to diagnose its occasional ailments.

Precision instruments such as the Allen Compression Tester have been developed to enable the mechanic to pin-point the source of trouble before he reduces the engine to a bewildering heap of parts. Modern automobile engines operate at high compression, and at a high ratio of compression between top and bottom of the piston stroke. Both compression and ratio of compression must be reasonably uniform for all cylinders or the car runs like a dog with a sore foot.

Operator removes split cavity and complicated part from Stokes Model 726 press at Allen Electric & Equipment Co., Kalamazoo, Mich.

Allen Model E 342 Compression Tester, plastic parts of which are made on Stokes molding presses.

The Allen Compression Tester enables the mechanic to determine simply, quickly and accurately the compression and ratio of compression for all cylinders. The tests also indicate whether the cause of trouble, if any, is faulty piston rings, damaged valves, ill-adjusted tappets, or leaking head gasket, and where these faults lie.

Plainly, the instrument is a precision tool, and its parts must be of a similar nature. Adapters and knobs for the Allen Compression Tester are made by Allen Electric & Equipment Co., Kalamazoo, Mich., on a Stokes Model 726 semi-automatic molding press of 50-ton capacity. This, by the way, is the newest and smallest of four sizes of the Model 726. Allen Electric uses it also for making switch parts, tuning knobs, meter cases, shunt housing covers and other parts. "A good fast machine for lots of production and adjustable for different types of work with a minimum of maintenance," says G. A. Schrepper, General Superintendent.

New Stokes Brochure on Vacuum Metallizing

So rapidly does the science of vacuum metallizing develop that it is difficult to stay abreast of it. Today's new technique is tomorrow's conventional method. For example, an earlier edition of the Stokes brochure on vacuum metallizing stated that the technique was unsuitable for internal coating. Now, internal coating of TV tubes is a working process on Stokes vacuum metallizing units, developed for the use of TV manufacturers in "aluminizing" TV screens and enhancing the brilliance of the TV picture.

The new brochure, entitled "Vacuum Metallizing", is a 28-page volume with brilliant six-color covers metallized by the continuous vacuum process. It contains a complete description of vacuum metallizing techniques, illustrated examples of its application to consumer and industrial products and descriptions and specifications of Stokes vacuum metallizing units of four standard sizes. A copy will be sent on request.

The new Stokes "Vacuum Metallizing" brochure. Copies available on request.

STOKES

F. J. STOKES MACHINE COMPANY

5534 TABOR ROAD, PHILADELPHIA 20, PA.

STOKES MAKES: High Vacuum Equipment, Vacuum Pumps and Gages/Industrial Tabletting, Powder Metal and Plastics Molding Presses/Pharmaceutical Equipment

Printed in U. S. A.

Huge reinforced plastics truck cab and wheels contribute to effectiveness of truck display

Spectacular— in Reinforced Plastics

COLORFULLY lighted, three-dimensional truck display—featuring a reinforced plastics tractor cab, huge reinforced plastics wheels, and an aluminum trailer—is the latest "giant" spectacular to be added to the gallery of New York's outdoor displays.

Located atop the new building of the Yale Transport Corp., the realistic truck model, designed by The Artkraft Strauss Sign Corp., New York, N.Y., measures 75 ft. from headlight to tailguard. The reinforced plastics cab alone is 13 ft. wide, from fender to fender, and stands 18 ft. high. Wheels have a diameter of 7 feet.

In selecting the fibrous glass-polyester resin laminate for the construction of the truck cab and wheels, the designers were attracted by the exceptional structural strength and the light weight of the material—an ideal combination for any outdoor spectacular continually exposed to the elements.

Because of the size of the reinforced plastics parts, fabrication of the various sections was carried on by Cinderella Mannequin Co., New York, N.Y., in several separate operations. Three plaster female molds were used for the cab—one mold for the hood and one mold for each half of the body—and a single magnesite female mold was used for making each of the six wheels of the display.

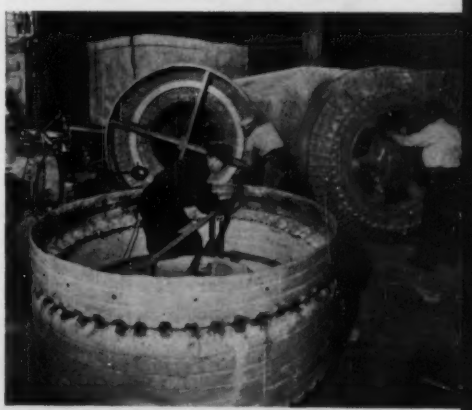
The three production molds for the truck cab were cast from full size models made by spreading a plaster coat over a burlap-covered metal framework and modeling the plaster by hand. Prior to lay-up, the interior of each mold was coated with a parting agent and then with Marco polyester resin.

Over these coatings, successive layers of resin-impregnated fibrous

(*To page* 221)

Photos courtesy Celanese Corp. of America

Molded hood and fenders of cab are carefully smoothed down by sanding



Reinforced plastics wheels, 7 ft. in diameter, are attached to metal frame

A Case of

Two materials molded together result in a laminated binocular case that defies destruction

Majority of component parts of binocular case are made of molded plastics, including core and cover molded of phenolic - impregnated duck, molded elastomeric vinyl outside cover, slush molded vinyl inside lining, vinyl belt straps, nylon shoulder straps, and several miscellaneous items

A COMBINATION of plasticized vinyl and phenolic-impregnated duck molded by a new technique into an attractive finished product, is creating comment in both the luggage and cabinet industries.

The first item to be molded by the new process is a binocular case designed for use by the U. S. Army Ordnance Corps. Taking advantage of the rich appearance and luxurious feel of vinyl, the handsome stippled exterior of the case is molded of the elastomeric material. Directly beneath the vinyl exterior —and literally fused to it—is a tough, rigid core consisting of three plies of specially prepared phenolic-impregnated duck. A slush molded vinyl lining which completely covers the inside of the case completes the unit. The resilient lining, in combination with sponge rubber pads at the rest points, provides ample protection for the costly binoculars.

Outstanding Durability

Since the development of the poroprism type of binoculars less than 80 years ago, carrying cases for these instruments have traditionally been fabricated from either leather or canvas, both of which are subject to deterioration by rotting, cracking, or crazing.

From the standpoint of price, durability, and appearance, the new Ordnance Corps cases have been proved far superior to the leather or canvas ones. The resistance of the new case to abrasion and scuffing greatly exceeds that of leather and, unlike leather, it will not mildew, rot, or crack. It is impervious to both fresh and salt water. Color —which cannot rub off—texture, and composition do not vary within a single unit nor between several different units. Similarly, the physical properties of the resilient vinyl exterior and lining and the rugged reinforced plastic core are predictable and constant. The rigidity and tensile strength of the new cases are less affected by temperature changes than are the properties of leather.

The vinyl exterior provides an excellent gripping surface, greatly reduces frictional noises due to

Strength and Beauty

rubbing or accidental dropping, and will not mar any surface upon which the case may be placed.

Prior to the adoption of the new construction for the binocular cases, a series of tests were conducted on eight types of plastic materials, including injection molded materials, laminated plastics, and a combination of fibreboard or fabric with plastics. Factors investigated during these tests were: abrasion resistance; flexural strength; weathering characteristics; and the effect of temperatures on the materials. The vinyl-reinforced plastic construction received the top rating.

Molds and Presses

The process used in the production of the new binocular cases required specially designed molds and presses. The body of the case is plug molded on a three-cylinder angle press, using hydraulic pressure for clamping and high pressure air for molding. The cover, a wide belt strap, and two fasteners for holding the nylon shoulder strap are molded on separate presses using the same basic technique—compression molding a vinyl sheeting onto an impregnated duck core under conditions of reduced pressure during the heating cycle. In addition to the high-pressure air and hydraulic systems on the press, special heating and cooling systems, which eliminate the use of steam and water, were installed.

In the production of the body of the case, three plies of phenolic-impregnated duck, previously cut to size, are first built up. The vinyl plastisol lining is then slush molded into the interior of this core. After the plastisol has cured, the lay-up is placed in the press. A sheet of vinyl, also cut to size, is placed around the outside of the core and the vinyl-reinforced plastic combination is then molded into a single integral unit. During the molding process, a rubber molding bag inserted into the interior of the laminate is inflated to serve as a force against the vinyl plastisol lining.

The new process, which requires six distinct operations, presented three major problems in setting up an efficient production line: 1) bonding the vinyl sheeting to the laminate during the molding operation; 2) preventing the phenolic resin from striking through; and 3) preventing the rapid deterioration of the molding bag due to heat of operation and plasticizer action.

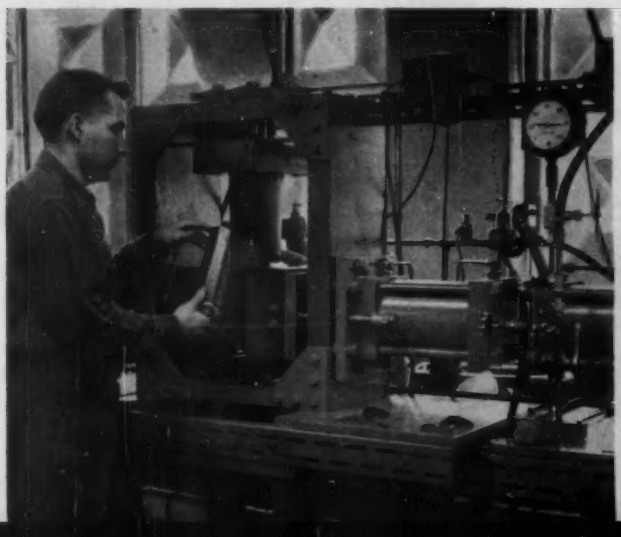
In solving the first problem, that of adhesion, a special primer was developed to facilitate the bonding operation. Careful control of resin and volatile content of the impregnated duck virtually eliminated strike-through. The molding bag, although greatly improved since the original design, still has to be replaced too frequently.

Experimentation in the company's laboratory has shown that the process can be used with any combination of polyester or phenolic resin, and with either glass cloth or duck. Further refinements of the process are under way, and the same techniques are due to be used for typewriter covers, precision instrument cases, or for similar applications where a functional combination of strength and beauty at a relatively low cost is desired.

CREDITS: Binocular case molded by Molded Insulation Co., Philadelphia, Pa.

Cut-away view shows three-ply construction of laid-up phenolic-impregnated core

Binocular case body is removed from three-cylinder angle press. Machine uses hydraulic pressure for clamping, high-pressure air for molding

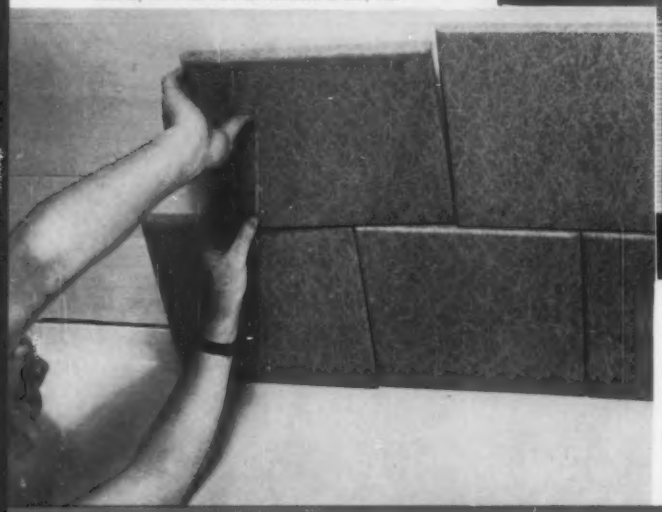


Production line of presses on which the various parts of the binocular case are molded under electronically controlled heat and pressures

Photos courtesy Molded Insulation Co.

Fibrous glass acoustical tile covered with Mylar polyester film is designed for quick installation. Use of the film covering, with its easy-to-clean, smooth surface, eliminates the dust-catching characteristics of many present-day porous tiles

Courtesy E. I. du Pont de Nemours & Co., Inc.



Courtesy Owens-Corning Fiberglas Corp.

In addition to increasing sound absorption efficiency, the Mylar acoustical tile covering is available in a variety of dyed or printed colors and patterns that offer new decorating possibilities in office (above), home, or store installations

THE FABULOUS FILM

Mylar film, used for phase insulation in electric motors, is ⅓ as thick as the material it replaces

High dielectric strength makes film suitable as a primary insulator on rectangular magnet wire and as layer insulation in transformers (below, right)

Photos courtesy E. I. du Pont de Nemours & Co., Inc.

Compact capacitor, wound from aluminum foil sandwiched between two strips of film (upper left) and then fitted into case (foreground), can operate in —60 to 150° C. range

EXTREME enthusiasm for a new plastics material is not unusual, but that extended to Du Pont's Mylar polyester film goes far beyond what may be normally expected. Even the currently quoted price of from $3 to $4 a lb. fails to dampen the curiosity of the hundreds of would-be users of this unusual plastic material.

Undoubtedly, the reason for this interest is the outstanding strength and the attractive appearance of Mylar. It can be produced in clear, beautiful film. Its impact strength is at least twice that of any known commercial film, and its dimensional stability is such that it remains flexible and stable from —140 to 302° F. or over. Tensile strength is 23,500 p.s.i., about ⅓ that of machine steel. In ¼- or ½-mil thicknesses, it is much stronger than most other films of greater thickness. In addition, the material can be easily metallized by

Non-tarnishable metallic yarn made by laminating aluminum foil between two sheets of film can be ironed, washed, or dry-cleaned without delamination

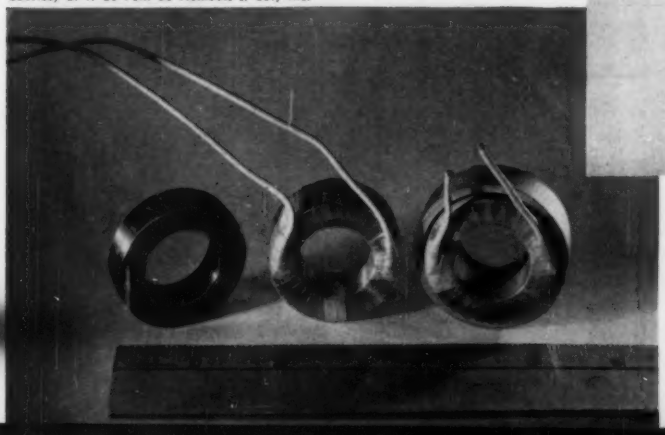
Photos courtesy E. I. du Pont de Nemours & Co., Inc.

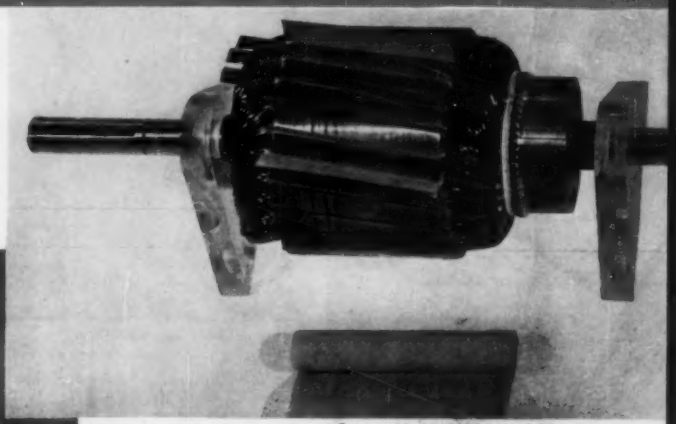
Aluminum-metallized Mylar film bonded to leather is used to fabricate attractive evening slippers that are long-wearing, easily cleaned, and unaffected by mildew

Outstanding physical, chemical, and electrical properties of Mylar polyester film are both stimulating sales of the material to established markets for film and developing new markets that are not commonly serviced by other types of film

Small solenoid (left) is insulated with Mylar polyester film (center) and placed in metal case (right). Outstanding properties of film in thin gages eliminates need for the bulkier impregnated glass cloth tape previously used for insulation

Courtesy E. I. du Pont de Nemours & Co., Inc.





Courtesy National Vulcanized Fibre Co.

Vulcanized fibre laminated to tough Mylar polyester film is used for slot liner insulation. The film is either bonded to one or both sides of the fibre or it is used between two sheets of the fibre

Chemically inert Mylar film, when laminated to the inside of a fibre or metal drum, creates a corrosion- and moisture-resistant surface. Such drums can then be used to ship corrosive chemicals that would ordinarily cause the fibre or metal to deteriorate

Courtesy E. I. du Pont de Nemours & Co., Inc.

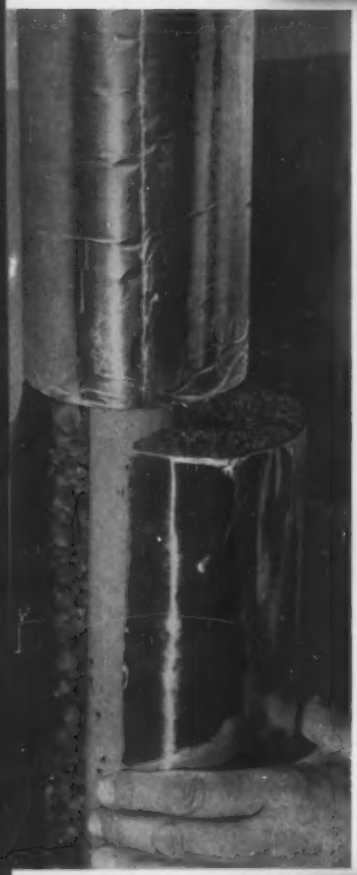
vacuum coating to give startling effects that can be utilized in many fields (see pp. 117 *ff*).

Illustrated on these pages are several of the outstanding applications of Mylar film which have appeared in recent months.

At the present time, electrical applications have absorbed the largest share of the material. The polyester film, used by itself or laminated to glass cloth, kraft and rag paper, asbestos, unvarnished glass, and other materials makes possible the elimination of bulkier insulating materials with savings in time and space. Its thinness is especially important in capacitor construction, which requires a film that is very thin in gage, yet is not fragile.

Mylar can be used as a dielectric in dry and liquid-filled capacitors; as tape insulation for motor and generator field coils, and solenoid coils; as insulation for round and rectangular magnet wire; as layer insulation, and insulation between turns in transformer coils; as a tough support for mica splittings; and for slot liner and phase insulation applications in motors.

Du Pont's new plant for Mylar film production has just started operations at Circleville, Ohio. All previous production of the material has been from a plant operating on a semi-works basis.



Moisture resistance of the polyester film, combined with aluminum foil, protects primary insulation—in this case, cork—from moisture contamination and thus helps to maintain insulating effectiveness

Courtesy E. I. du Pont de Nemours & Co., Inc.

Courtesy Minnesota Mining & Mfg. Corp.

Courtesy Reeves Soundcraft Corp.

Magnetic tape fabricated of Mylar won't shrink or stretch and has a break strength of 6 to 8 lb.—about 2½ times that of other tapes used

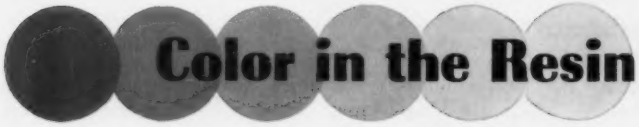
Strength and abrasion resistance of polyester film tape is also useful for applications such as bundling (right), masking, splicing, and sealing

COLOR IN PLASTICS

Part 3 of a Symposium in Print

The first eight articles in this series appeared in the July and August issues under the following titles: The Problems of Color in Plastics; Color Surveys: 5 Methods; Color Sells Plastics; Types of Colorants for Plastics; Acrylic Color Techniques; Color in Styrene and its Alloys; Coloring Polyethylene; and Colorants for Vinyls.

In the present issue, experts in the field deal with color in the cellulosics and in resin-rubber copolymers. In the October issue, problems of color as related to polyesters, fluorocarbons, and epoxies will be discussed, as well as special color effects in thermoplastics. Each of these articles has been especially prepared for MODERN PLASTICS Magazine.



Color in the Resin-Rubber Plastics

by William J. Coughlin

IN VERY recent years a whole new family of thermoplastics based on the copolymerization of styrene with other resins and the alloying, or mixing, of copolymers with rubber has come into being. These materials are called by a number of names, including that of "resin-rubber copolymer blends."

The great advantage of these new and different thermoplastics lies in their versatility. Having excellent toughness and rigidity, plus a combination of high hardness, chemical resistance, high heat distortion temperature, easy formability, and good electrical properties, and being readily injection molded, extruded, or formed, the resin-rubber blends have proved suitable for use in refrigerator components, automobile interiors, luggage, materials handling equipment, pipe, signs—probably in more different fields of application than any other group of plastics.

The materials themselves being so superior, it behooves the producers and compounders to be especially alert in the matter of colorants in order that the materials, when colored, will be enhanced rather than degraded in properties.

Colors are added to these "gum" plastics to broaden sales appeal, to add distinctiveness, as a means of identification (e.g. the pipe field), and as a method of extending the useful life of the end product. Since colors are so important to the resin-rubber blends, considerable attention is being given to making such colors permanent, or stable, under all reasonable processing and service conditions. Generally, a color change is easily detected and this change is often not only very undesirable, but quite often completely unacceptable.

There are many special color problems in dealing with the gum plastics, because the end-use applications of the material are so broad.

The choice of colorants is limited by the processing and molding conditions required. As compared to polystyrene, higher mixing, processing, and molding temperatures are employed in working with the resin-rubber blends, because of the more difficult flow of the copolymers. These conditions limit the choice of colorants to the more heat-stable pigments.

An attempt has been made to keep the scope of this article as broad as possible. Discussions, applications, and conclusions will encompass the whole field of resin-rubber copolymer blends. However, it should be understood that most of the evaluations and experience have evolved from work done on Kralastic, a resin-rubber blend of a styrene-acrylonitrile resin, and a butadiene-acrylonitrile rubber.

CHOOSING PIGMENTS

There are numerous factors to be considered when matching, producing, and selling colored resin-rubber copolymers. Many of these factors tend to make the choice of pigments very restrictive.

The most important factors are: A) heat stability; B) weather resistance (including light stability); C) effect of pigmentation on physical properties; D) chemical resistance; E) processing; F) color matching problems; and G) cost.

A breakdown and discussion of these considerations follows.

Heat Stability

The problem of heat stability is acute with thermoplastic resins, which must be heated for molding or forming operations. Since, at the same time, physical properties and color must be maintained and held uniform, these processing conditions eliminate all but the most heat-stable pigments for the acrylonitrile resin-rubber copolymer blends.

Although molding temperatures are normally in the 400 to 500° F. range, these temperatures may be exceeded at times. Provisions must, therefore, be made, insofar as possible, to withstand such abnormally high molding temperatures.

Weathering Resistance

Because it is often necessary that color and physical properties be maintained after extended outdoor use, many applications require excellent weathering characteristics. Temperature changes, humidity, moisture, and exposure to light may have adverse effects on color. The proper pigmentation can increase the useful life and over-all product

William J. Coughlin received his engineering degree from Rensselaer Polytechnic Institute in 1950. He also attended the University of Michigan and Hillyer College.

Mr. Coughlin is associated with the Kralastic Development Dept. of Naugatuck Chemical, Div. of United States Rubber Co. His experience includes color work with an industrial coatings company as well as his present work on color development and pigmentation of resin-rubber blends.

performance under such conditions.

Black pigments give the optimum outdoor performance, whether color stability or physical properties are the criteria. Blacks, however, often lack the necessary sales appeal, and, naturally, plastics are not limited to one color. When considering weathering resistance, other satisfactory pigments are cadmium reds and darker browns, tans, and grays. Rutile titanium dioxide is recommended for white or very light colors. Better performance, in fact, will be obtained if rutile titanium dioxide is used whenever white base pigments are required, regardless of the color. The use of rutile-type pigments insures less chalking and better control after outdoor exposure.

Effect of Pigmentation

The type of pigmentation has a very definite effect on the physical properties of resin-rubber blends. Excessive pigmentation tends to degrade or modify physical properties. White stocks require a much higher than normal pigmentation, and the degree of pigmentation must be carefully controlled to maintain physical properties. Iron oxide red and brown pigments tend to give lower than normal physical properties per se, in addition to being less stable in the temperature range required. This can often be avoided by using cadmium reds with or without black to give the required red or brown with the desirable physical properties and stability.

An interesting example of the effect of a pigment on physical properties is the use of yellow or white pigments to help maintain dimensional stability of parts subject to sunlight or radiant heat. When the part temperature is in a critical range, the effective heat resistance may be raised by the use of these pigments, especially yellow, which reflect a large percentage of the infra-red rays. When absorbed, infra-red rays can raise the temperature of the molded piece to a critical point and thus affect the dimensional stability.

Chemical Resistance

Generally speaking, the resin-rubber copolymer itself determines the level of chemical resistance. The pigmentation does not tend to improve the very good general resistance of the acrylonitrile copolymer blend stocks to chemical attack, but if the types of pigments used have good enough chemical resistance, the over-all chemical properties can be maintained. When evaluating new pigments or applications, however, consideration should be given to the effect of these pigments on the chemical resistance.

Processing

Particle size, solubility, and ease of dispersion are also factors in the choice of colors. Pre-blending often aids dispersion, but must be followed by mechanical action. Pigments that agglomerate must also be avoided. When a very small amount of a color is required, processing and color control is often improved by using a larger amount of a less effective colorant. Thus, the margin of safety is improved.

Dry coloring, or simply tumbling dry pigments and molding granules together, is not generally a satisfactory method of coloring resin-rubber copolymers. The opaque or semi-opaque nature of these compounds usually requires a large pigment loading to obtain the desired color. Thus, dry blending is not satisfactory since the granules will not pick up the required pigment, and dispersion during the normal molding action is not sufficient to give desired uniformity.

Color Matching

Just what types of colors can be obtained with the resin-rubber blends? Certain restrictions are imposed by the opacity of these materials and the relatively limited number of pigments that can be used.

Nevertheless, a wide range of opaque colors is available including pastels, light creams and ivories, yellows, and whites. Dark colors are readily produced.

It is very difficult, if not impossible, to match the resin rubber copolymers to a transparent material that contains a trace of dye as the colorant. This depth and brilliance of color can not be duplicated.

Cost

A quick survey of the factors that must be considered in the selection of pigments will indicate that important cost considerations must be made. Costs are always a problem, but the combination of expensive pigments, relatively high pigmentation, and costly mixing procedures produces a special cost problem in this field. Unlike the situation in some of the other plastic resin fields, there is very little use of fillers to cheapen resin-rubber blends. Experience to date indicates that fillers modify physical properties, especially toughness and flow.

The use of inexpensive fillers, and the consequent lowering of price, is a problem that development personnel might well scrutinize more closely than in the past.

COLORANTS

A more specific discussion of the types of pigments that are used in resin-rubber blends follows. Mention is also made of some of the pigments that are not recommended. This discussion is broken down by color types.

Red

Cadmium reds are used extensively since they are the most heat and light stable. Although much progress has been made in developing bright-clean pigments, there is still room for more improvement. These pigments are relatively expensive.

B.O.N. (Beta-oxy-naphthoic acid) reds are very light stable, but cannot be used when heat stability is required. Calendering and forming stocks may use this type pigment as

(*To page* 222)

Cellulosics: Color Unlimited

by Robert I. Hawley, Jr.

THE coloring of cellulose ester plastics, which include cellulose acetate and cellulose acetate butyrate, is a highly developed science, so much so in fact, that the manufacturers of these molding materials assume the expense of maintaining staffs of skilled and experienced colorists. In addition, these manufacturers conduct continuous laboratory research and outdoor exposure tests at weathering stations located in various parts of the United States in order to determine the best coloring agents available.

Of all the plastics in current use, the cellulosics are susceptible to one of the widest ranges of colorability in transparents, translucents, and opaques, and in the production of variegations or mottles, and metallic pearls and pearlescent color effects. Illustrating the adaptability of colored cellulosics is their widespread use for automotive accessories and parts such as steering wheels, armrests, panels, dials, and control knobs, which require strict adherence to the car's color designs and motifs.

Through the use of both dyes and pigments, the range of colors available in cellulose ester plastics is virtually unlimited. Dyes for these plastics are organic in nature and, for transparents, must be soluble in some suitable type of compatible liquid medium and have the property of producing the desired color without haze.

Pigments for coloring cellulosics may be organic, inorganic, or metallic. They have little or no solubility and are incorporated in the plastic by mechanical means. Whereas dyes permeate the cellulose esters and become an integral part of the mass, pigments produce color by reflected light from the very fine colored particles dispersed and suspended throughout the plastic mass. Incorporated in very small concentrations, pigments produce haze when viewed by transmitted light; greater concentrations produce translucent colors and heavy concentrations produce opaque colors. All truly transparent colors of cellulosics, meaning those without haze, are produced with dyes of one type or another and they are distinctive for their brightness and clarity in a finished molded article. Dyes may be also used in combination with a white opaque pigment to produce a variety of bright and highly pleasing translucent colors.

Coloring With Dyes

Generally speaking, cellulose ester plastics colored with dyes are more susceptible to fading from sunlight and molding at high temperatures than those colored with pigments. When colored with dyes, they will generally withstand a molding temperature of 420° F. for 10 min. without noticeable color change. This is not true of all dyes since some colors must be produced with dyes that are known to be sensitive to heat and likely to show color change at temperatures much lower than 420° F. However, some dyes are considerably less heat-sensitive and will withstand even higher molding temperatures. Pigments, on the other hand, produce colors that are much less sensitive to heat than dyes and some types can be molded at temperatures up to 500° F. without any noticeable change in color of the cellulosic material. The chief advantage of dyes over pigments is their ability to produce transparent colors without haze, and for many applications, this advantage outweighs the frequently encountered disadvantages of lower resistance to light and heat and a tendency to migrate or "bleed" into other colors or materials on contact. Table I gives, in a general way, comparative characteristics data for various coloring agents.

Light Stability

Selection of coloring agents for cellulosics on the basis of their resistance to ultra-violet light—sunlight stability—is of the utmost importance. While many applications of cellulosics are seldom if ever exposed to sunlight in actual use, the fact that they may be displayed in

Table I—Properties of Colorants for Cellulosics

Type	*Heat Stability Approx. % Conc.* 0.01	0.03	0.06	*Light Stability Approx. % Conc.* 0.01	0.03	0.06	*Bleeding*
Azo reds	Poor	Fair	Good	Poor	Poor	Fair	Poor
Azo yellows	Fair	Good	Good	Fair	Good	Good	Poor
Anthraquinone	Fair	Good	Good	Fair	Fair	Good	Poor
Oil-soluble reds	Poor	Poor	Fair	Poor	Poor	Fair	Poor
Oil-soluble yellows	Fair	Good	Good	Poor	Poor	Poor	Poor
Triphenylmethane	Poor	Fair	Good	Poor	Poor	Fair	Poor
Fluorescent	Poor	Poor	Poor	Poor	Poor	Poor	Poor
Fluorescent (vat)	Fair	Good	Good	Poor	Poor	Fair	Poor
Cadmium reds, yellows	Good	Good	Good	Good	Good	Good	Good
Ultramarine blues	Poor	Fair	Fair	Fair	Good	Good	Good
Iron oxides	Good	Good	Good	Good	Good	Good	Good
Umbers & Siennas	Good	Good	Good	Good	Good	Good	Good
Phthalocyanine greens	Good	Good	Good	Fair	Good	Good	Good
Phthalocyanine blues	Poor	Fair	Good	Fair	Good	Good	Good
Chrome yellows and oranges	Poor	Poor	Poor	Good	Good	Good	Good
Molybdate oranges	Poor	Poor	Poor	Fair	Good	Good	Good
Carbon blacks	Good	Good	Good	Good	Good	Good	Good
Migrasines	Poor	Poor	Fair	Poor	Fair	Fair	Poor
Wool dyes	Poor	Fair	Fair	Fair	Fair	Good	Poor

Table II—Concentration of Coloring Agents Used in Cellulosics

Type	*Approximate % Concentration*	*Resistance to Normal Outdoor Exposure*
Azo dyes	0.5	Good
Anthraquinone dyes	0.5	Fair
Oil dyes	0.5	Poor
Triphenylmethane	0.5	Poor
Fluorescent dyes	0.5	Poor
Cadmium pigments, iron oxides, chrome yellows and oranges	1.0	Excellent
Umbers and siennas	1.0	Good
Ultramarine blues	1.0	Fair
Phthalocyanine pigments	0.5	Good

store windows or at point of sale, makes it necessary to use materials with best possible resistance to fading from sunlight.

For purposes of this selection, dyes can be separated into approximately three groups. The first group would include those dyes that are known to fade very badly when exposed to sunlight and which would be used only as a last resort in order to produce a required color. These dyes begin to fade within twenty-four hours when exposed to sunlight. The second group would consist of dyes that could be expected to fade after less than three months of outdoor exposures. In the third group would be listed the dyes that would be likely to exhibit very little color change after continuous outdoor exposure for several years. Only rarely does it happen that a particular dye will produce the exact color desired and also afford unlimited sunlight stability.

Pigments fall normally into a single group since they will usually withstand several years of outdoor exposure without any readily apparent change of color. It is well to note, however, that the ability of any coloring agent to resist fading from outdoor exposure depends in considerable degree on the amount or concentration of the coloring agent used. Table II shows approximate concentrations of some general types of coloring agents used in cellulose ester plastics and an indication of their resistance to normal outdoor exposure without appreciable fading.

There can be no definite correlation between fading of colored plastics from actual exposure to sunlight and accelerated fading in laboratory tests. However, in order to provide a means for year-round evaluation of coloring agents, accelerated aging in a standard Atlas Fade-Ometer or under a General Electric sunlamp is normal procedure. These tests are conducted in accordance with A.S.T.M. test designation D 620-49. It is very safe to state that any color change noted in these tests will usually be confirmed by actual outdoor exposure test, but it is possible that the degree and character of color change may differ in the outdoor tests. Due to the inability to obtain a direct correlation of fading by laboratory methods, most manufacturers of plastic molding materials operate a program of continuous actual outdoor exposure tests of coloring agents.

It is customary to make outdoor exposure tests only of those coloring agents that have been tested in the laboratory and judged to be promising. Tennessee Eastman Co. maintains continuous outdoor exposure tests at Arizona Testing Laboratories, Phoenix, Ariz.; Everglades Testing Laboratories, Fort Myers Beach, Fla.; and at the factory location in Kingsport, Tenn. Each coloring agent to be tested is represented by twelve panels, either single panels 4 by 9 by ⅛ in. or composite panels made up of test specimens 1 by 9 by ⅛ in., 1 by 9 by 1/16 in., or 2 by 9 by ⅛ inches. The exposure schedule requires that test specimens be removed for observation at the end of 4, 8, 12, 16, 20, 24, 28, 32, 36, 42, 48, and X months. The "X" specimen may be removed at any desired time after 48 months. The boards on which the test panels are placed face due South at an angle of 45° and are painted a dull black. The panels are mounted ¼ in. away from the surface of the boards. When the exposed samples are returned for observation at the intervals stated above, they are first washed and then subjected to careful laboratory comparison and analysis.

Special Effects

For some applications it is not unusual that the color requirements involve luminescent or fluorescent properties. Such colors in cellulose ester plastics may be produced by the addition of fluorescent dyes or pigments. If "black light" is used in connection with these materials, many unusual effects are possible.

Another group of coloring agents afford pearl-like effects and, in other cases, a sheen simulating metals. The most attractive "pearls," including white pearl, are produced by the use of natural fish scale pearl essence. Other very pleasing colors can be made by a combination of natural fish scale pearl essence and dyes. Synthetic pearling agents may be also used to produce similar color effects. Pigments do not lend themselves to this type of coloring since they tend to obscure the pearlescent effect.

A second group of pearls are those made with metallic powders. Many types of suitable metallic powders are available but several conditions require consideration when using

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Robert I. Hawley, Jr., is supervisor of the Tenite color laboratory at Tennessee Eastman Co., Kingsport, Tenn. He began work with the company in 1935 after graduating from Lincoln Memorial University at Harrogate, Tenn. His entire length of service, which consists of 19 years, has been devoted to the coloring and color problems of Eastman cellulose ester plastics.

METALLIZED PLASTICS SHEETS

Shine in New Applications

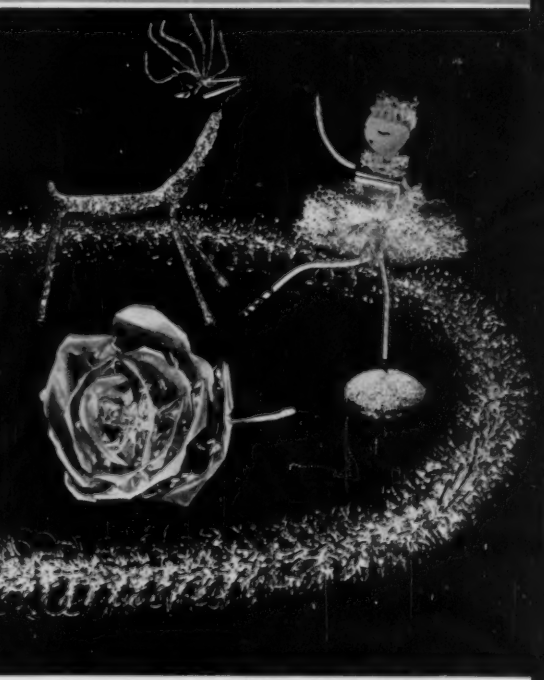
Metallized materials extend plastics design potential into those areas of industry heretofore considered as wedded to metal

METALLIZED plastics sheets are moving up in the plastics world. Originally conceived for use in a minor capacity as sequins or as decoration for Christmas cards and novelties, the plastics sheets with a thin, permanent coating of metal have now successfully invaded such important new fields as refrigeration, automobiles, home appliances, packaging, and displays—and a number of other progressive manufacturers of durable goods are already eying the material with more than idle curiosity.

Vacuum Metallizing

According to the three leading suppliers of metallized plastics sheets—Coating Products, Englewood, N. J.; Gomar Mfg. Co., Inc., Newark, N. J.; and Hy-Sil Mfg. Co., Revere, Mass.—several factors are responsible for the sharp increase in sales of the material.

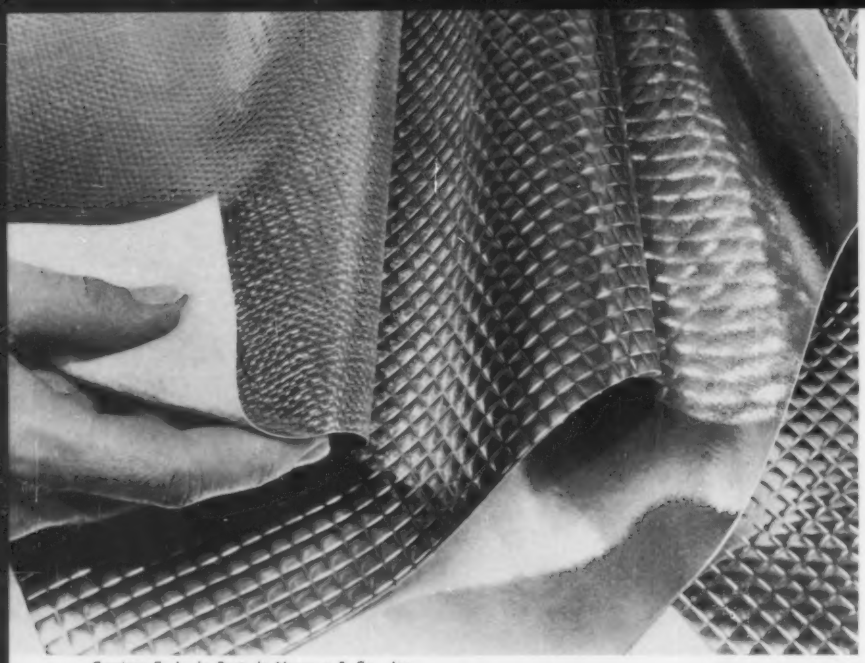
For one, recently improved processing techniques have made it possible to apply the highly reflective and long-lasting metallic coating to continuous rolls of plastics sheeting more quickly and efficiently than could be done even two years ago. While there are several methods of applying the coating, including spraying, painting, or printing, practically all the plastics sheets used today are vacuum metallized (see "Vacuum Metallizing of Plastic Sheet," MODERN PLASTICS *31*, 122 (Dec. 1953). Using this method, the coating, which can be either alumi-



Photos courtesy Coating Products

Christmas ornaments, formed from ordinary pipe cleaners and die-cut strips of metallized acetate, combine eye-appeal with the light weight and strength of plastics

Junior "spaceman" can see clearly from inside a metallized acetate viewer in helmet. The outside of viewer presents a mirror-like, reflecting surface



Courtesy E. I. du Pont de Nemours & Co., Inc.

Metallized Mylar polyester film can be laminated to fabrics or vinyls and appropriately embossed for use as paneling, upholstery, or in making handbags, belts, and shoes

num or silver, depending upon the end result desired, is applied by vaporizing the metal in a high-vacuum chamber and condensing the vapor on the surface of the plastic sheet.

Another factor that has contributed to the growth of the metallized sheet industry has been the increase in types of metallized plastics sheets available to meet specialized needs. Originally, cellulose acetate was practically the only plastic sheet that was being metallized and sold. Today, while metallized acetate still remains the volume leader, particularly in highly decorative applications, the list of metallized plastics sheets has been swelled by the addition of metallized styrene, metallized cellulose acetate butyrate, and, only recently, metallized Mylar polyester film (see pp. 110 *ff*).

Coating Products and Hy-Sil supply all four types of metallized plastics materials. Gomar also supplies all four types as well as rigid vinyl. The materials may be had from all three companies in roll form or sheet form, in gages up to 0.030 in., and in widths up to 40 inches.

Design Potential

Among the first to realize the potential of metallized plastics sheets that can be easily fabricated into unusual shapes was the toy designer. The number of toys and novelties today that are fabricated entirely of metallized sheet or which use the material for component parts covers a wide area, ranging from the Marx-man "Skyroplane" model airplanes fabricated of silver-metallized styrene to a vacuum formed gold-metallized butyrate mute used in conjunction with the metallized molded styrene toy trumpet being marketed by Emenee Industries, Inc., New York, N. Y.

One very popular application for the material in the toy and novelty market has been in the fabrication of pinwheels, streamers, and similar action toys for the younger children. According to the manufacturers of these items, the shimmering reflection of the material as it whirls around holds a special fascination for the youngster.

In the field of pseudo-scientific toys, one-way viewers made of metallized acetate sheet and installed in space goggles, space masks, or space helmets add much to the basic appeal of the toys. Using a special process, acetate sheet can be coated in such a way that you can see through it clearly in one type of light, but will get a mirror-like reflection under another type of light—a technique, incidentally, which has been put to good use in the design of several unusual displays. Placed in front of an advertising message in such displays, the metallized sheet is alternately transformed by a flashing light from an opaque mirror to a transparent window.

Eye-Appeal

Since it is a basic merchandising tenet that eye-appeal can make or break a product or promotion, metallized plastic sheet is finding one of its most important outlets in brightening up various novelties, ornaments, packages, Christmas cards and greeting cards, signs, and displays. The versatility of the material is especially evident in such applications. Metallized plastic sheet can be laminated to paper, cardboard, wood, fabrics, or even metal. It can be embossed, formed, folded, die-cut,

Entire top of mute (right) for metallized molded styrene trumpet (below) consists of vacuum formed metallized butyrate sheet. Gold color of sheet matches trumpet

Courtesy Toy Guidance Council

stitched, or sewn. Pressure-sensitive or self-adhering backings can be easily applied to the material and printing or silk screening shows up excellently on the metallic surface.

With this range of fabricating techniques at his command, the ability of any manufacturer to create "new and unusual" effects is virtually limited only by his imagination.

Prince Matchabelli perfumes, for example, are packaged in an unusual display set-up box that utilizes an arched gold mirror-like backdrop. Mary Chess, Inc., New York, N. Y., also a perfume supplier, uses an attractive gift package arranged like a section of a chessboard, in which the background consists of a sheet of gold-metallized acetate cut out to suggest a castle.

Another packaging technique for making effective use of metallized plastics sheeting as an economical sales stimulant has been developed by several manufacturers in the watch and jewelry line. These manufacturers laminate a sheet of metallized plastic to the back of a display box and then paste a velvet or satin covering over the sheet so that only a gold or silver trim is visible around the edges.

Because of its highly reflective properties, the metallized plastics sheets can also be used as an inexpensive mirror for toys, low-cost compacts, novelties, or ornaments.

Vacuum Forming

Although in the form of flat signs, metallized plastic sheet has enjoyed an excellent reputation for some time, the recent emphasis on vacuum forming as a fabricating technique has considerably improved the potentialities of the sign and display field as a major market for metallized materials.

Since metallized materials take silk screening so well, the sheet can be pre-printed with a message or illustration in distortion and then vacuum formed so that the colors register in position on the formed piece. An attractive display—strong, light in weight, and with the special three-dimensional qualities of metal—can thus be produced without the expensive fabrication which had previously been required to achieve this type of effect. Particular emphasis in the vacuum formed display and sign field has been plac-

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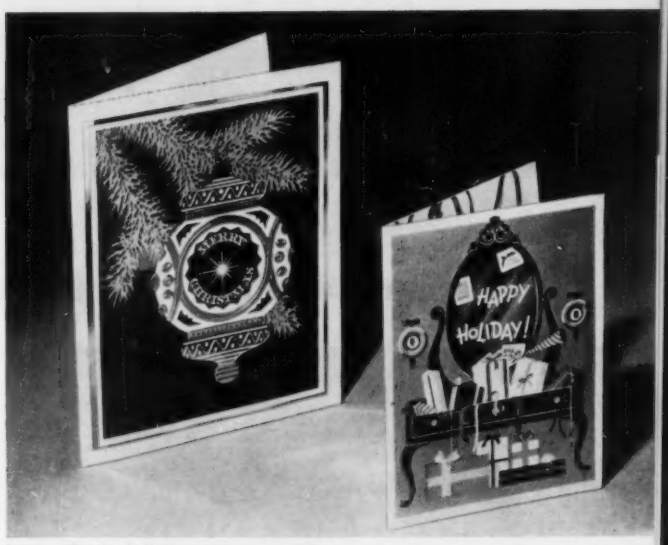


Ease of fabrication of versatile metallized materials permits the creation of unusual and realistic effects in Christmas cards

Courtesy Coating Products

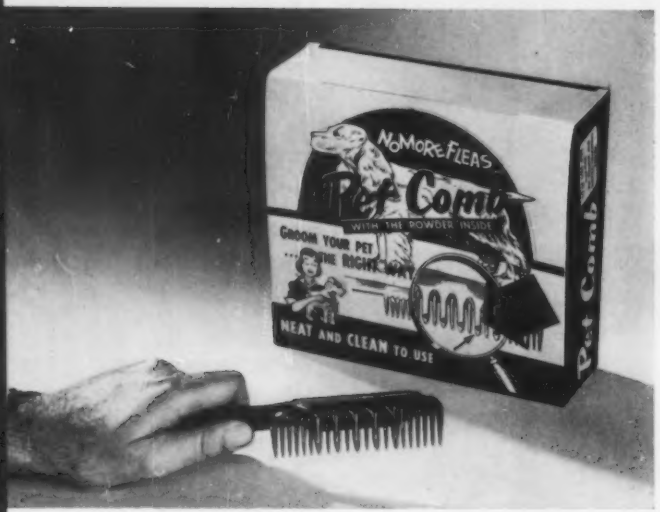
Courtesy Coating Products

Display set-up box for perfume is dressed up by adding a glittering backdrop fabricated of gold-metallized acetate sheeting

Applications for metallized plastic sheeting run the gamut from silk-screened flat and vacuum formed signs to shimmering pinwheels and clock faces

PLASTICS

Combination Comb and Flea Powder Dispenser



Grooming the dog can be a relatively simple operation with the use of a new combination comb and flea powder dispenser molded of cellulose acetate butyrate. The sturdy comb is easy to clean, stainproof, and fits comfortably in the palm of the hand.

The back of the comb is so designed as to provide a powder well for the flea or grooming powder. An elongated sliding cover moves along channeled grooves in the opening of the well to securely close the back once the comb is filled. Five enlarged teeth in the comb are hollow and allow the powder to trickle down through the teeth and onto the animal by gravity-feed. While in use, the openings of the teeth are actually under the hair, allowing the powder to be placed close to the skin.

The comb is injection molded in a two-cavity mold on an 8-oz. machine and is gated at the end of the handle.

CREDITS: Manufactured by Victory Plastics Co., 81 Apsley St., Hudson, Mass., Cellulose acetate butyrate supplied by Eastman Chemical Products, Inc., Kingsport, Tenn.

Desk Pad With Cigarette Dispensing Feature

Combination memo pad holder and cigarette dispenser molded entirely of high-impact styrene delivers a cigarette each time the pad is opened. A pack of king-size or regular cigarettes can be loaded into the magazine-like top which is covered with a friction-fit lid. A molded-in hinge mounted to the top by a pin-and-socket arrangement engages a single cigarette when the top is in a closed position. When the top is raised, the cigarette falls into a holding groove in the hinge, ready to be removed. A slot in the base of the pad engages a lug which is incorporated in the hinge to join the two sections. The base has a raised molded-in rim which secures and positions a memo pad. Included with the desk set is a perpetual calendar.

The "Cig-Flip" Pad is injection molded in five separate parts in a five-cavity mold on a 6-oz. machine. The two sections of the magazine and the lug are permanently cemented into position.

CREDITS: Molded by Garray Plastics Co., 32 Washington Ave., Belleville, N. J. for Artplex Inc., 2 Broadway, New York, N. Y. Molded by Damascus Tool Co., Union, N. J.

PRODUCTS

Compartment Bag Converts to Oversize Pad

A versatile vinyl covered 3-compartment bag that zips open to a pad four times its closed size can be used to carry picnic supplies, bathing suits, towels, diapers, etc. When fully open, the Tote-A-Pad is ideal for use in a playpen, at the beach or on a picnic. The outside and reverse vinyl surfaces are water and stain proof.

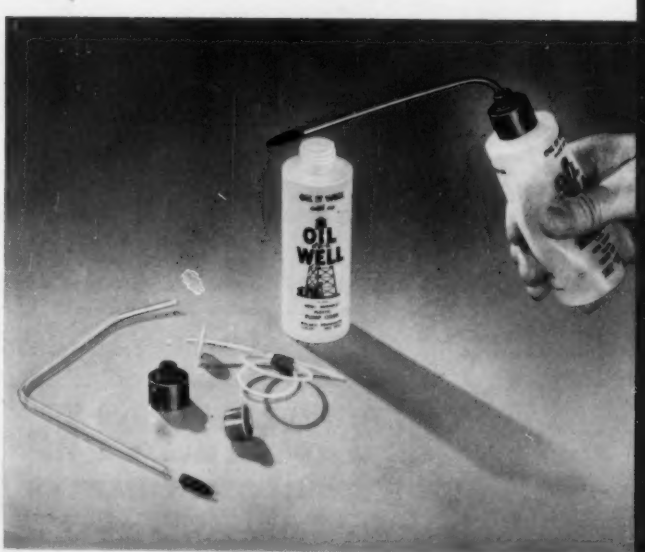
The pad is available in two outer trims—linen weave, a 4-gage embossed vinyl; and bamboo weave, an 8-gage embossed vinyl. Reverse side is 4-gage linen weave. In either case, the padded sections are filled with Tufflex, a cellulose wood product which serves both as an insulating and a cushioning material. All seams are machine stitched; 4-gage white vinyl is used as a seam reinforcement. Handles are attached to the compartment bag with metal gromments. Pads are available in a number of colors in any combination of two colors.

CREDITS: Manufactured by Padded Accessories, 217 S. Waverly St., Yonkers, N. Y. Vinyl and Tufflex supplied by Harte & Co., Inc., New York, N. Y.

Leakproof Oil Can With Interchangeable Spouts

A polyethylene squeeze bottle is used in an oil can called "Oil-Well," which has interchangeable rigid and flexible spouts of cellulose acetate butyrate and polyethylene tubing for versatility in operation. A leakproof polyethylene cup seal, fitting into the neck of the oil can, prevents the lubricant from spilling while in use. The spouts are introduced through a phenolic closure cap which threads into the can and completes the seal.

Controlled flow can be maintained by regulating the amount of hand pressure applied to the container. Because of the translucency of the materials, the oil level in the container and spout is visible at all times. The entire contents of the oiler can be utilized and refilling is accomplished by removing the cap to add additional oil.



CREDITS: Manufactured by Kelsey Products, 429 Howe Ave., Passaic, N. J. Polyethylene bottle molded by Royal Mfg. Co., Inc., Prescott, Ariz. Polyethylene tubing and cup seal by Irvington Varnish & Insulator Co., Irvington, N. J. and Lumelite Corp., Pawling, N. Y. Phenolic cap molded by Armstrong Cork Co., Lancaster, Pa. Butyrate tips molded by Gries Reproducer Corp., New York, N. Y. Polyethylene by E. I. du Pont de Nemours & Co., Inc., Wilmington, Del. Butyrate by Eastman Chemical Products, Inc., Kingsport, Tenn.

PLASTICS ENGINEERING*

F. B. Stanley, Engineering Editor

New Concept of Hot-Runner Molding

Advantages of hot-runner molding become more practical with the development of the principle of external runners

THERE are almost as many different approaches to mold design for fully automatic injection molding as there are breeds of dogs, and just as many differences of opinion as to the best way to do the job.

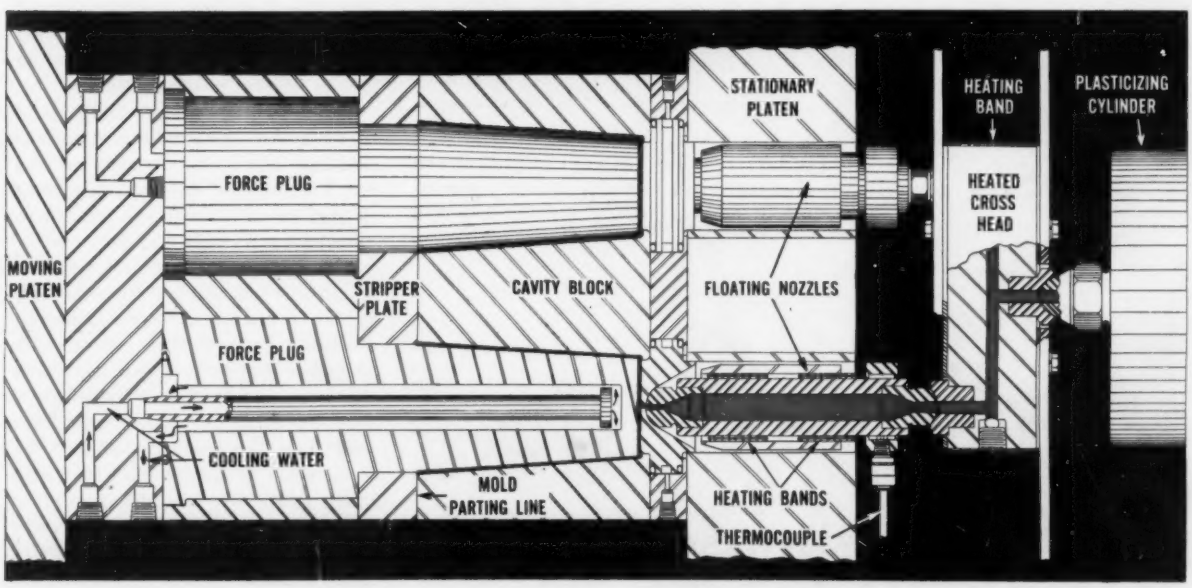
Should the entire shot—with all sprues, runners, and parts connected—be ejected as a unit, or should the gates be cut while the mold is still closed, and then the runner network and the parts ejected separately? Should the gates be cut after the mold is open, but before ejection? Will pin-point gating, in conjunction with hot-runner mold design (thus eliminating from the ejection problem all but the parts), be better?

Some authorities argue vehemently for one procedure while others are just as positive that another has more advantages. There is, however, quite general agreement that not all parts lend themselves to automatic molding and, for those which do, that the mold must be especially designed for that purpose.

There has been a great deal of talk about hot-runner molds, but so far it has been nearly impossible to place an order for such a mold with a tool maker unless the mold design has been completely worked out by the company wishing to place the order. In other words, the know-how of hot-runner mold design is far from being wide-spread. Among other things, it requires knowledge of the answers to the following questions: How much heat will be needed in the runner plate? How can there be assurance of uniform temperature throughout this plate? Where shall the thermocouples be placed for controlling the temperature? How shall the hot-runner plate be insulated from the colder mold, and what should be used for insulation? Can we be sure the gates will not freeze?

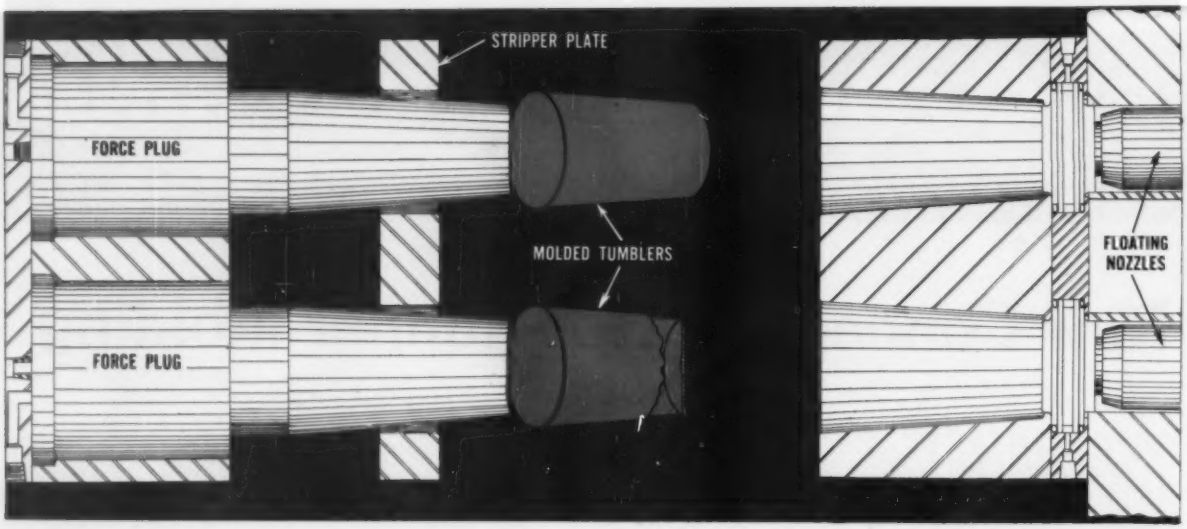
External Hot Runners

A new approach to the elimination of cold runners, which seems to get around all the problems in hot-runner mold design, has recently been proved-out in actual operation by

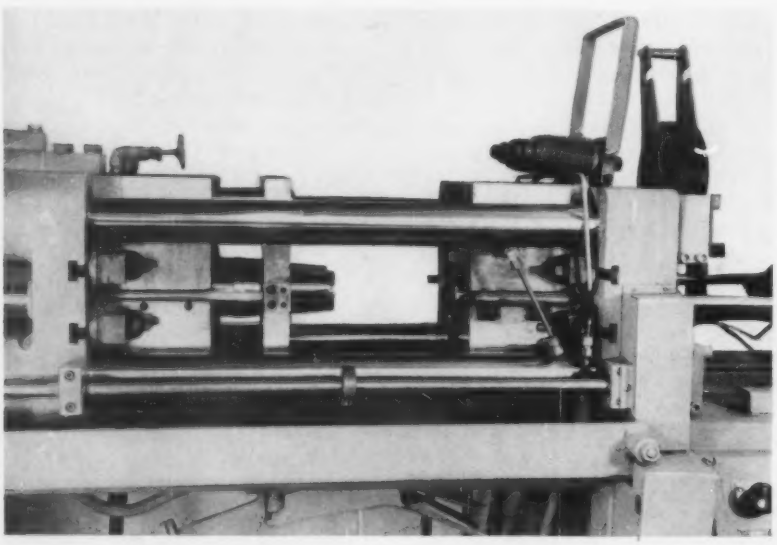


Details of floating nozzles and cross head used in external hot-runner molding. While these components are shown here designed for two-cavity operation (molding tumblers), they can be readily adapted to single- or multiple-cavity injection molding

* Reg. U.S. Pat. Off.

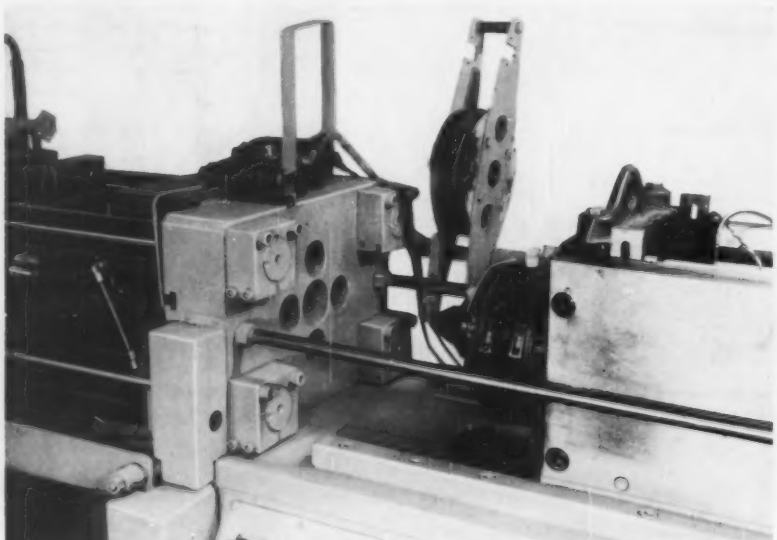


External hot-runner molding of tumblers produces de-gated molded pieces. As mold opens, tumblers stick on force plugs, breaking pin-point gates located at center of bottom of each tumbler; as it opens more, stripper plate forces pieces off plugs



Two-cavity tumbler mold mounted on machine; double nozzles and cross head are disengaged

Die platen with holes for multiple nozzles; connecting nozzle and cross head are retracted



the Engineering Dept. of Improved Machinery, Inc. For want of a better name it is called Multiple Nozzle or External Hot-Runner molding. The following description of this novel development has been prepared by George W. Whitehead of Impco.

In this method of molding, the die is so designed as to allow a nozzle or an arrangement of nozzles to gate directly into the cavity or cavities. It can be used with one, two, three, four, or more nozzles, so arranged as to afford good solid contact with the die without leakage. Leverage is important and must be considered for each particular arrangement of nozzles in order to prevent leakage. One, two, or three nozzles present no particular problem; however, four nozzles require use of two groups of two nozzles each.

One nozzle has been used extensively before in external hot-runner molding; however, two or more had not been applied in practice to any extent. Impco, therefore, decided to investigate multiple nozzles.

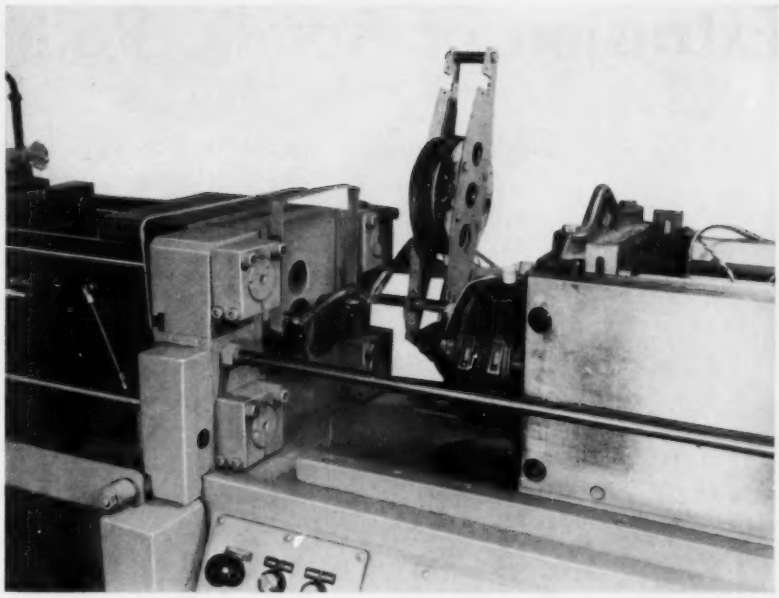
The advantage of this procedure is that it eliminates runners and sprues, a condition which is highly desirable in automatic molding. A so-called hot-runner mold would, therefore, appear to be the answer. But hot-runners, when they are built into the mold, have the objectionable characteristic of being inaccessible when starting up, or when a gate plugs for one reason or another. Furthermore, the problem of insulating a hot-runner from a relatively cold mold is one that is not susceptible to easy solution.

By the use of multiple nozzle arrangements, all these objections are eliminated. The multiple nozzle arrangement can be readily disengaged from the die. It makes contact with the die only at the very tip of the nozzle and, therefore, a major insulating problem is eliminated.

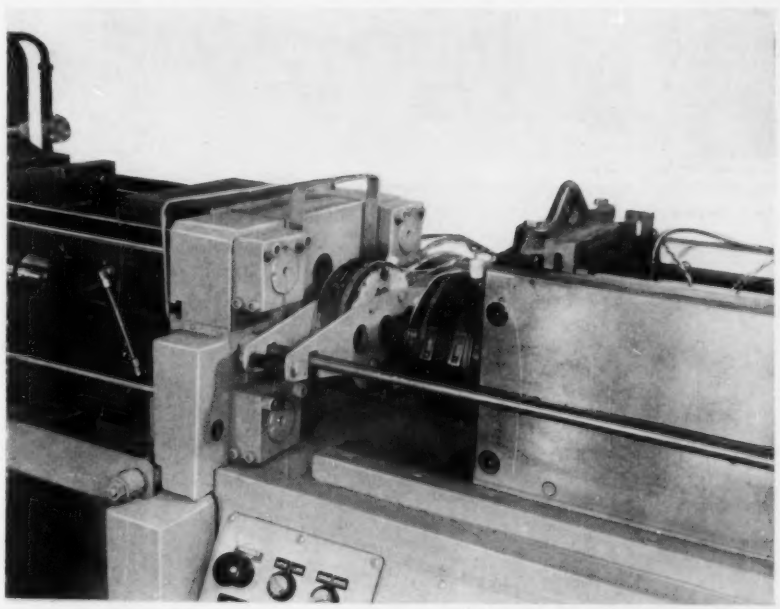
The drawing on page 123 shows the cut-away cross section of the nozzle arrangement to show how this method was applied in molding two 12-oz. tumblers. It should be noted that the only contacts of hot metal with the relatively cold mold are the actual tips of the floating nozzles. All other parts—the nozzles, the cross head, the connecting nozzle, and the heating cylinder—are surrounded by air. The cross head is protected against the danger of radiation loss by means of asbestos board disks.

Thus the mold may be cooled to whatever degree desirable without affecting the nozzle, or hot-runner arrangement.

Independent temperature control of the bottom insert which contacts the nozzle permits regulating the temperature at that point to the required degree.



Double nozzles in place of holes in stationary die platen; cross head is retracted



Photos courtesy Improved Machinery, Inc.

Nozzles and cross head in place, heating cylinder moved forward, ready for operation

Many Ways to Use

The potential of this multiple nozzle arrangement is great. There are many ways in which it can be used. For example, the use of only one nozzle, off-centered, might be applied to a single cavity which can be gated on the side or at one end. Furthermore, a combination of an off-center nozzle, multiple nozzle, or even a center nozzle, with under parting line gate shearing offers unlimited possibilities.

The photographs accompanying this article show the actual set-up of an Impco HA2-65 machine with a two-cavity tumbler mold and a double nozzle arrangement.

Details and comments on this set-up follow:

Heating Cylinders: Rear heating bands controlled by one thermocouple and proportioning type pyrometer. Front heating bands controlled by one thermocouple and proportioning type pyrometer.

Cross Head: Heating band connected to front of heating cylinder control.

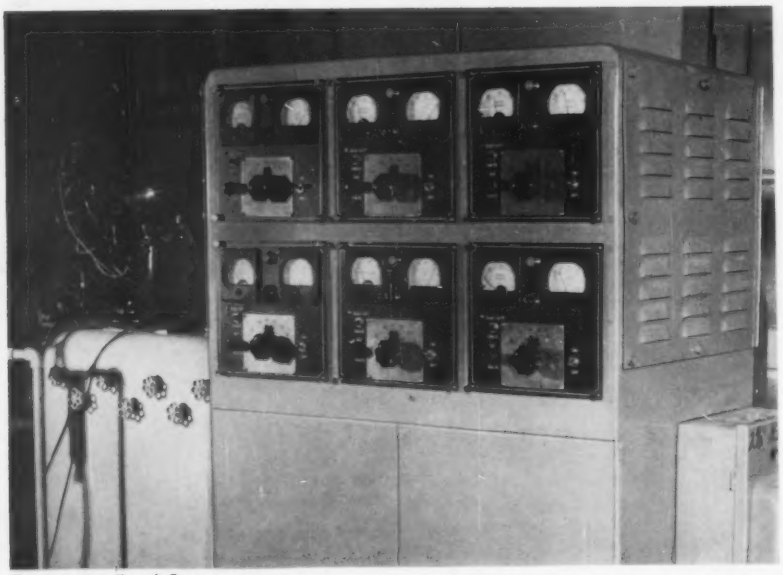
Nozzles (two): Heating band controlled by only one thermocouple. It was found unnecessary to control each nozzle. Thermocouple in one nozzle controlled both nozzles.

Operating Conditions: Two cavity tumbler die. Cycles per hour—300 plus. Weight of shot—2.6 ounces. Material—impact styrene. Pounds plasticized per hour—50.

The basic feature of this mold design centers around the use of an auxiliary heated nozzle on a heated cross-head feeding into a multiplicity of heated nozzles, with the entire arrangement insulated by air from the mold except at the contact points between nozzle and mold. This arrangement eliminates all insulation problems which to date have presented the biggest drawbacks to more wide-spread use of hot-runner molds.

Extrusion of Acrylic Rod

Precise control of temperatures throughout the production process has made possible the extrusion of accurately dimensioned, strain-free, high-quality stock



Photos courtesy Kemtek Corp.

Fig. 1—Electronic control equipment for regulating temperature on six separate zones of the extrusion machine—four zones on the extruder cylinder and two zones on the die

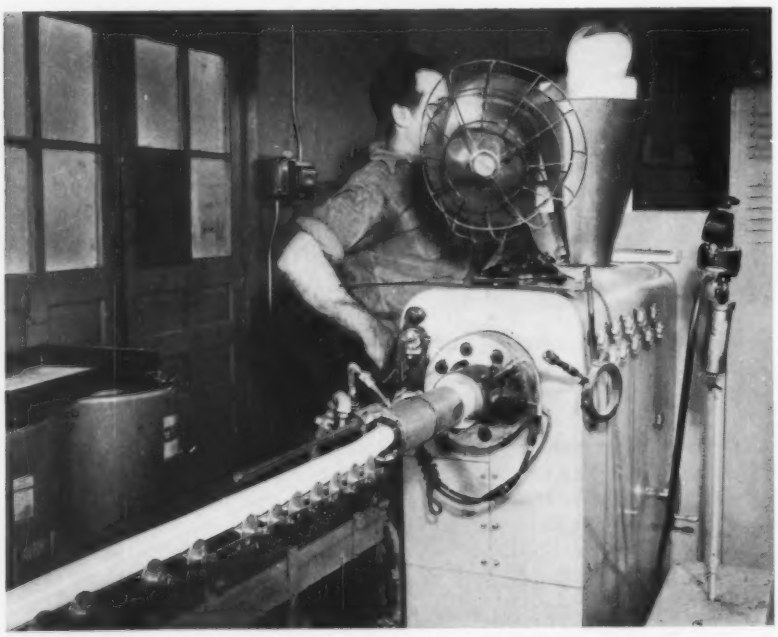


Fig. 2—Closeup of die producing 1¼-in. diameter opaque white acrylic rod. Material issuing from die is pulled onto conveying rollers machined to one-half of rod diameter

UNTIL just recently, attempts at producing acrylic rod stock by extrusion resulted in commercial disappointment. It was almost impossible to keep the rod concentric; the product had to be centerless ground and subsequently polished to meet specifications. In addition, extruded rod exhibited strains that had to be relieved by time-consuming and costly annealing.

By contrast, high-quality, strain-free acrylic rod could be produced by casting. Here, too, however, diameter control presented a problem that, in most cases, had to be solved by grinding and polishing.

But the inherent economic advantages of the extrusion process could not be ignored and, as research continued, extruders found out how to produce extruded stock to dimensional tolerances—but it still required annealing.

Final step toward the desired end has been taken by Kemtek Corp., Newark, N.J. That company now reports commercial production of extruded acrylic rod, in a range of diameters and colors, which is both concentric and strain-free as it comes off the extruder conveyor.

According to Albert J. Pastine, president of Kemtek Corp., the secret of success in this extrusion operation can be attributed directly to exact temperature control. This temperature control is exercised not only at the extruder and the die, but also in the cooling bath through which the extruded rod passes prior to cut-off. Rod is now being produced in diameters from 1/16 to 1½ in. and in some 60 colors as well as clear. All colored material is produced by the dry coloring method, yet control is so good that exact color matches are accurately made.

Temperature Control

Kemtek has been extruding acrylic rod for some time with fair success, but it was not until the past few months, when all of its 2½-in.

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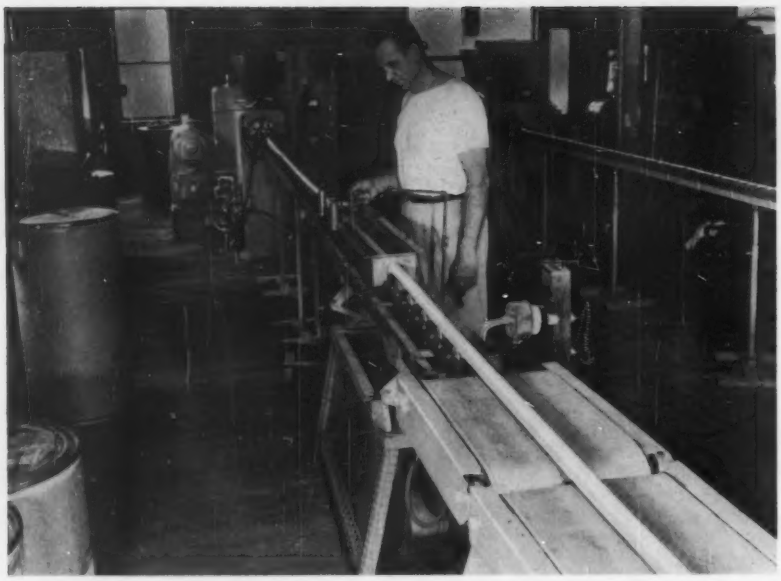


Fig. 3—Over-all view of extrusion set-up. After passing over shaped conveyor rolls, rod moves through hole in flexible baffle into a thermostatically controlled water bath

Fig. 4—On automatic cut-off equipment, rod moves under a guillotine knife until its end actuates a Microswitch at a predetermined length, causing the knife to drive down

extruders were equipped with the latest stepless Modern Plastics Machinery Corp. electronic temperature control, that it was possible to turn out the superior quality rod which is being produced today. This new control equipment does not operate on an on-and-off cycle and, therefore, completely eliminates overshooting or undershooting of the desired temperature.

Figure 1 shows one of these controls with the necessary electronic equipment for handling six separate zones. These six zones on the extrusion set-up consist of four zones on the extruder cylinder and two zones on the die. For practically all acrylic rod extrusions, the zonal temperatures are set as follows: with the cylinder zone nearest the hopper at 360° F., the next zone towards the die end is at 350° F., the next at 350° F., and the final cylinder zone at 275° F. The inner die temperature is 340° F., and the outer end of the die is set at 350° F. with a screw speed of approximately 31 r.p.m. on the 2½-in. extruders, present production ranges from 58 to 70 lb./hour. This is a marked increase over that attainable before the installation of the new temperature control.

Some exact comparisons are as follows: On ½-in. rod, previous production high of 45 lb./hr. has been increased to 58 lb./hr.; on ¾-in. rod, production has been increased from 48 lb./hr. to 61 lb./hr.; on 1¼-in. rod, the previous high of 55 lb./hr. has been increased to 70 lb./hour.

This gain in output is partially due to a decided reduction in scrap or rejects and partially due to the fact that the accurate control of temperature has permitted the extruder screw speed to be increased from 12 to 15 percent.

Shaped Conveyor Rollers

The extrusion set-up as now being used at Kemtek is shown in accompanying photographs. Figure 2 shows a closeup of a die which is producing 1¼-in. diameter opaque white acrylic rod. As the soft material issues from the die, it is immediately pulled onto conveying rollers which are machined exactly to ½ the diameter of the rod being extruded. These conveyor rollers are set at an angle to the forward travel of the rod and, because of their exact shape as well as the angular set, keep the rod perfectly round.

The rod as it issues from the die is oversize; it must be drawn down by the pull rolls to the required diameter. The pull rolls are located at the end of the last conveyor just before the automatic cut-off so that when the rod reaches these rolls it is no longer soft although still warm.

Annealing Bath

Figure 3 is an overall view of a rod extrusion set-up. As the rod leaves the shaped rollers, it passes through a hole in a flexible baffle into a water bath. This bath is thermostatically held at a temperature of 80° F. The thermostat controls a circulating pump which adds cool water as needed to keep the bath

at the desired temperature. According to Kemtek, this cooling bath is the secret to the elimination of post-extrusion annealing operations. The bath keeps the rod from cooling too rapidly and also forms a skin on the surface which aids in holding concentricity. As the rod issues from the cooling bath it passes through a second baffle. The purpose of these two baffles is to trap the water in the cooling bath without marring the surface of the rod. The rod then passes over several more shaped rollers and thence onto a conveyor belt which, in conjunction with the pull rolls, gives the necessary force to pull the rod from the die along the rollers and through the bath.

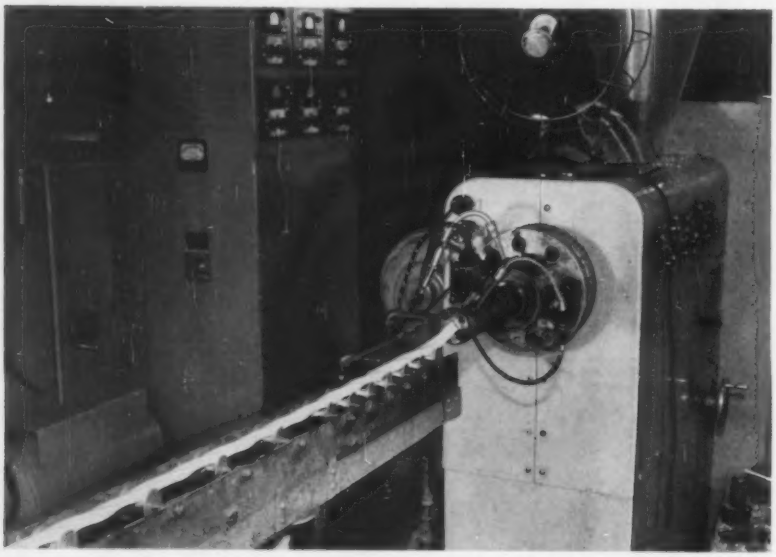


Fig. 5—Close-up of extruder producing spiral rod of rectangular section. As the rod emerges from the die, it is twisted by hand until it reaches the pull rolls (see below)

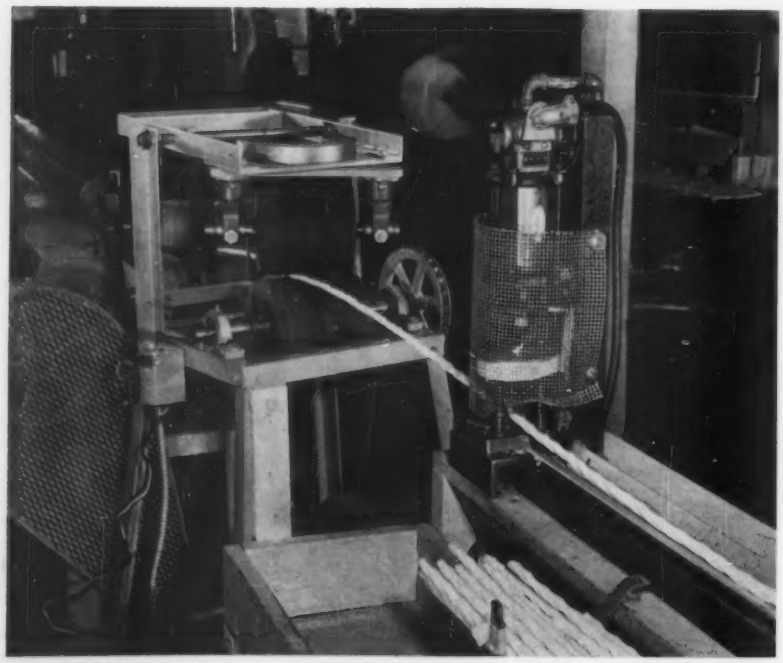


Fig. 6—Spiral rod is drawn through pull rolls which are placed at an angle to each other, the exact angle being determined by the pitch which is desired in the twisted rod

All the rod in the Kemtek plant is automatically cut to length by a solenoid-controlled, air-operated guillotine knife. Figure 4 shows a closeup of the equipment being used for the cut-off operation on a small diameter rod. The rod is pushed under the guillotine knife, which may be seen in the center background, until the end of the rod contacts a Microswitch which is set to give the desired length. As the end of the rod contacts the switch, the air cylinder drives the knife down and cuts the rod off. As soon as it is cut, the trough in which the rod is laying tips towards the operator, to the left in the photograph, and delivers the rod to the stack shown. In the same illustration, the operator is checking concentricity and diameter of extruded rod with a "go and no-go" gage.

Figure 5 is a closeup of another extruder producing spiral or twisted rod of rectangular section. As the rod issues from the die at the beginning of the extrusion operation, it is manually twisted until the rod reaches the pull rolls. Then (see Fig. 6), the spiral rod is drawn through pull rolls which are placed at an angle to each other. This angle is determined by the desired pitch of the twisted rod. As the rod passes through the rollers it is being constantly turned, simply because one flat of the spiral follows the nip of the rollers. The speed of these pull rolls must remain constant in order to achieve uniformity of spiral. If the rolls were speeded up, the spiral would tighten up and the section would become decidedly thinner. Conversely, if they were slowed down, the spiral would tend to open up and the dimensions increase.

Summary

By accurate temperature control of all phases of acrylic rod extrusion and of the cooling bath through which the extruded rod passes, dimensions of the rod can be held to desired tolerances and strains can be relieved in a single, continuous operation. By control of dry coloring, colors can be matched from batch to batch. By the use of suitable pull rolls, twisted rod of uniform pitch can be continuously produced.

What Causes Mold Erosion?

Radioactive tracer techniques, applied by the use of irradiated sprue bushings in a transfer molding set-up, give a true picture of factors influencing mold wear

by A. P. Landall*

FOR almost as many years as phenolics have been molded, the problem of mold erosion has plagued the plastics industry. In the early stages of the industry, molds were made from a wide variety of alloys and were not hardened. As time went by, it was learned that hardening gave a measure of freedom from mold wear. Steel, hardened within a range of 50 to 60 Rockwell C, soon became the accepted standard of the industry. As further knowledge was acquired, the kinds of alloys used were gradually narrowed down to a chrome steel of the SAE 3312 type, the type of alloy which is in general use today.

Chrome plating was early recognized as an excellent means of extending the life of the tool. A hard chrome plate (0.001 to 0.003 in. thick) has been found to extend the tool life ten-fold. This is not entirely satisfactory, however, since chrome plating often chips, which means that the tool must be taken out, stripped, repolished, and rechromed; a costly process, incurring loss of production as well as the customer's wrath. With the advent of large moldings, such as television cabinets, the problem of plating large tools is magnified. The size of available plating facilities becomes a limiting factor, and the possibility of mold chipping in large tools becomes more likely.

Chrome plating, therefore, has not been used to any great extent on large part tools to prevent wear and repair. If chrome plating is not the answer, then the molder may well ask, what is the solution to costly down time for repolishing worn tools?

Since metallurgy has not provided the answer, the molder obviously must turn to the molding powder manufacturer. Can the formulation be modified to give greater freedom from wear? What are the effects of process variables on tool wear? What types of materials are best from this standpoint? What are the effects of pressure and temperature on tool wear? These and other questions immediately come to the mind of the molder.

Photos courtesy General Electric Co.

Gamma count of plastic slug molded through irradiated sprue bushing is determined with scintillation counter. Slug is inside cast-iron bell which serves as protective enclosure

The material supplier's knowledge is often limited to generalizations and impressions acquired over the years. He knows (or thinks he knows) that mica-filled and asbestos-filled heat-resistant materials cause greater mold wear than general-purpose woodflour-filled materials. He has been told, and has observed, the effect of general-purpose materials which contain mineral modifiers against those general-purpose materials which do not contain mineral modifiers.

This immediately puts him on the horns of a dilemma. If mineral modifiers caused erosion, how then to eliminate them and still obtain the improved appearance that they give? How shall he formulate colors without using inorganic pigments and still retain color over the temperatures and times occurring during the molding cycle? Can he use any inorganic materials? If so, how much?

Time-Consuming Tests

Obviously, the answers to these question are not easily obtained. The material supplier might, of course, devise a test mold and run it until wear occurs. Such a test would be extremely time-consuming and would not lend itself easily to a thorough investigation of all the factors involved in mold erosion. Due to the cumbersome nature of such a test, the best he could hope for would be a study of a few isolated variables, or he might make a chemical analysis of the molded part for traces of mold steel. How-

*General Electric Co., Chemical Materials Dept., Pittsfield, Mass.

ever, this avenue is not adequate since the quantity of mold steel eroded in any one shot is so minute, as compared to the iron already present in both free and combined form, that even a spectrographic analysis would not pick up the traces of metal involved. What is obviously needed, on the basis of calculations, is a test which would detect one part of mold steel in twenty million.

With the growing knowledge derived from nuclear physics, a method of detecting and measuring minute metal particles through radioactive tracer techniques suggests itself. If such a test could be developed, it would fulfill all the requirements for a fast, easily duplicated test and provide a number which could be assigned to a particular variable. Such a test would be capable of a high degree of accuracy and reliability.

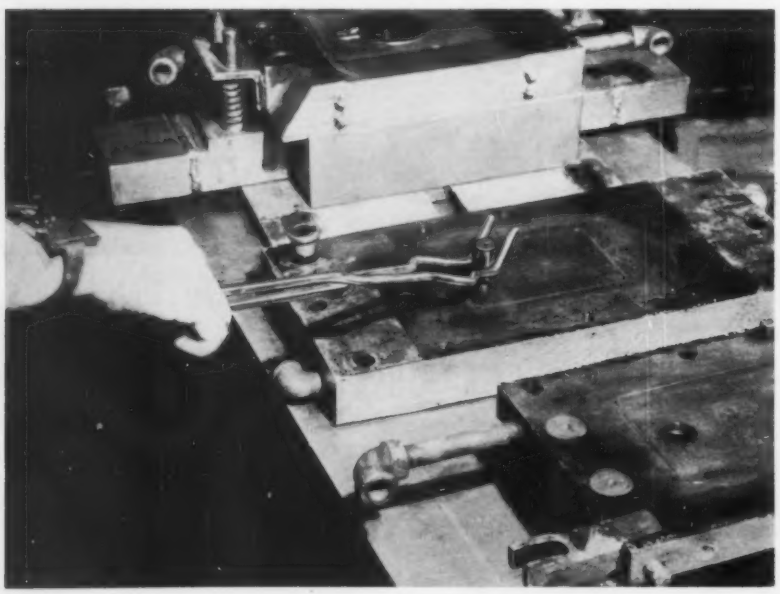
Approach to Tracer Techniques

In order to employ radioactive tracer techniques, the amount of erosion occurring in an average molding material had to be first measured by some other method in order to calculate the degree of radioactivity to be induced. A test was devised in which the molding powder was extruded past a torpedo or spreader. The spreader was weighed and measured carefully before the start of the test. Material was extruded continuously past the torpedo until visible signs of erosion or wear occurred. After weighing and measuring the torpedo and determining the amount of molding compound used, it was a simple matter to calculate the amount of metal worn off per pound of material extruded past the torpedo.

The question might be asked; why not use this as a mold erosion test? The answer is simple. It could be used except that it requires two men to run the test over a week-long continuous operation. Further, time is also consumed in repolishing the torpedo after each test. The reproducibility is also subject to question since scratches would afford a toehold where the material might start eroding more quickly. While this test certainly is not particularly feasible, it is satisfactory for providing a general idea as to the magnitude of metal eroded for the purpose of calculating the amount of radioactivity to be induced for use of tracer techniques.

First consideration was given to using a drinking tumbler mold which might duplicate, in miniature, a television cabinet mold. We were counseled against using a completely radioactive mold since the cost of activating such a large mass of steel would be prohibitive, even if such a large object could be conveniently placed in the atomic pile. Furthermore, the hazard to personnel with such a large radioactive mass would be very difficult to overcome. A mass such as this would require extensive shielding and remote control apparatus for molding.

Sprue bushing, irradiated to provide source of gamma radiation, is placed into one mold section with long-handled tongs, prior to measurement of erosion in the mold steel



Hazards Considered

Consideration was next given to building a light shell of steel which could be activated and then clamped into the cavity or onto the plunger of the tumbler mold. We were counseled that such a shell of steel would have to be very thin (in the neighborhood of 0.062 in.) in order to be within the safety limits established after irradiation. This would certainly involve considerable machining difficulty.

Since the heat of the atomic pile is great and there is a tendency for molecular rearrangement, there was also the chance for dimensional changes which would be sufficiently great to cause considerable difficulty in installation. Again the personnel hazards in handling such an object and installing it in the mold were considered to be too great. A further deterring factor was that it would be diffcult to obtain accurate counts with such an irregular shape. It was decided, therefore, to employ a transfer mold of the type employing a sprue bushing for transfer of material through the runners and gates and into the part.

The level of radioactivity required for accurate counting is a function of the mass of the material to be activated. Also, it was necessary to keep the mass as small as possible in order to keep personnel hazard at a minimum. The sprue bushing employed weighed approximately 100 g., which appeared to be a satisfactory mass to handle easily. The particular mold involved lent itself readily to easy assembly and disassembly. (It had been noticed that the sprue bushing on this type of transfer mold was subject to erosion rather early in the life of the mold, which was another reason for choosing such a part for irradiation.) The radioactive bushing could be easily handled with long tongs, placed in the mold, and the mold bolted together very rapidly and with relatively little hazard.

The next factor to be considered was the composition of the steel in the sprue bushing. SAE 3312 mold

(*To page* 137)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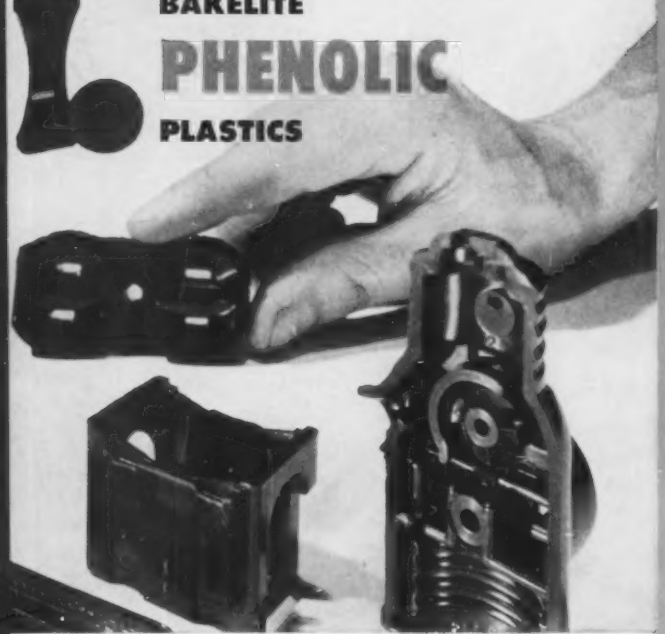

Electrical parts molded from BMG 5000 Brown 15 are finely detailed, have good finish.

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After mold with radioactive sprue bushing has been installed in press, area is monitored with irradiation survey meter to determine safe working limits for operating personnel

steel has a typical analysis as follows: 3.5% nickel; 1.5% chromium; 0.45% manganese; 0.17% carbon; remainder—iron.

If these elements were to be irradiated, what would be the products and what would be their half life? Since it was decided to count gamma rays, the type of emission had to be determined also. The chart of the nuclides show that the above elements when irradiated, yield the following products:

Nickel 64 is the only nickel isotope which yields gamma rays. Only 1% of the nickel present is in the form of nickel 64 which gives Ni_{65} at 2.56 hr. half life. This could be ignored. Carbon yields no gamma rays, and manganese is present 100% as Manganese 55. Mn_{55} yields a high degree of gamma radiation when irradiated to Mn_{56} with 2.59 hr. half life. Chromium is present to the extent of 4.4% Cr_{50}. This yields chromium 51 with 27 days half life and a reasonable amount of gamma radiation. Iron, the major constituent, is present to the extent of 0.33% iron 58 which yielded iron 59 with a 45-day half life and a reasonable amount of gamma radiation. It appeared that iron and chromium had a sufficiently long half life and emitted sufficient gamma radiation to be the type of material desired for further work.

The bushing was irradiated in an atomic pile at an average thermal flux of 4×10^{12} neutrons per sec. $cm.^2$ until approximately 37 millicuries radiation was obtained. This appeared to be sufficient activation based on the calculations derived from the torpedo test. In order to decay the short-lived isotopes formed, the bushing was allowed to remain in a lead box for two weeks. This allowed for the decay of nickel 65 and manganese 56 to below interference levels.

Protection

The radioactive bushing was handled with long tongs and quickly placed in position in the bottom mold member. The other member was immediately placed in position over the bushing and the mold members bolted together. This left one end of the bushing exposed. It was immediately covered with a lead block 3 in. thick, until the remainder of the mold could be assembled. During all phases of installation of the bushing and reassembly of the mold, the work was monitored with a Radiation Survey meter. The entire assembly operation was completed in less than 1 hr. with apparent safety. The mold was then bolted in the press and steam connections made. The part to be molded consisted of a slug 2 in. in diameter by 2.5 in. high. This part is ideal for counting since it possesses sufficient mass in a relatively small volume. Survey with monitoring devices indicated that if personnel stayed at least 12 in. away from the mold, the radiation would be less than 300 mr. per 40 hr. week—which is a safe weekly dosage.

Mold temperature was arbitrarily set at 330° F., a good average working temperature. Molding pressure was set at 3.6 tons/sq. in. based on the pot area. Preheat temperature was set at 250° F. ± 7° F. The test was run by pilling the material and preheating it in a dielectric preheater. The charge to the mold was handled with tongs and the press closed. After sufficient curing time (3¼ min.), the mold was opened, the cull pushed off with a long brass rod, the part removed with tongs, and the mold blown clean with an air blast. This cycle could then be repeated for as many variables as required.

Radioactive Metal Picked Up

As the material flowed through the sprue bushing, it picked up minute quantities of radioactive metal. This quantity varied, depending on the erosive characteristics of the material being molded. The molded part contained a sufficiently low order of radioactivity (less than that contained in a luminous wrist watch dial) so that it could be safely handled without any personnel hazard. The part was placed within a shielded metal housing and gamma counts determined using a scintillation counter.

Since the radioactivity of the sprue bushing is constantly decaying as well as the metal which has been eroded into the molded part, gamma counts alone cannot be used as an absolute measure of mold erosion. For each variable or series of variables, it is necessary to run one or more standard compounds.

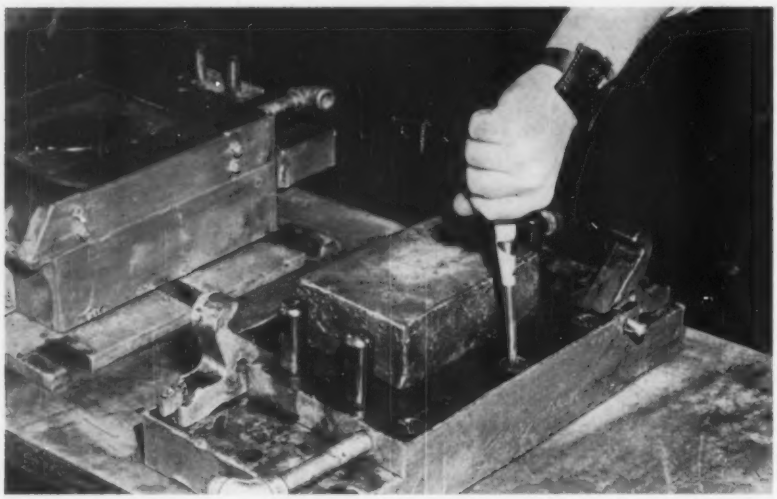
One of these standards (any average general-purpose type compound) is arbitrarily assigned the number 1 and all other materials expressed as a ratio to it. Thus, the decay factor of the radioactive metal is nullified and a constant for comparison is always available. Tests have shown the ratio of a given material to the standard remains constant over a six-month period even though gamma counts change as time goes by.

From the foregoing description of the test employed, it can readily be understood that the time required

for one complete mold erosion test is in the order of 30 min. as opposed to approximately three weeks for any other method .The method used allows for the study of a large number of variables quickly and with complete safety to personnel, providing proper protective precautions are taken.

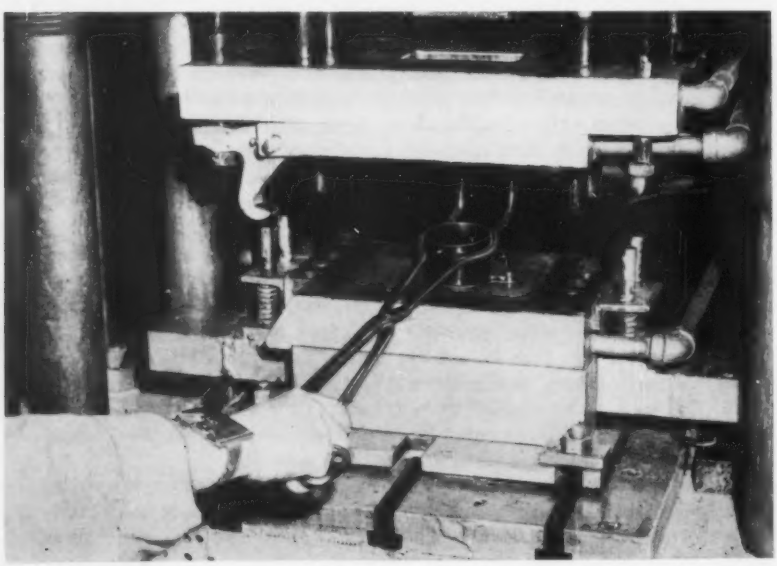
This leads to some of the factors in molding materials which influence mold erosion and factors which might have no appreciable effect on erosion. It has been said that talc causes mold erosion. We have found that the incorporation of talc in moderate amounts can have a marked effect on mold erosion. In the amount normally used as a mineral modifier, talc can raise the erosion rate up to 20 times that of a material containing no talc. It should be remembered that talc is the lowest mineral on the Mohs scale of hardness. Other minerals which might be higher on the Mohs scale might exhibit a relatively low rate of erosion. Apparently erosion is tied in with crystal structure and not with hardness alone. Some pigments used in the coloring systems of colored materials also have been found to exhibit high rates of erosion when they are compounded into molding materials.

Considerable work has already been done to determine whether or not resin modifications have any effect on mold erosion. It can be said that there appears to be no significant change in erosion rate with changes in the type of phenolic resin used. Materials which might be added to resins to aid in grinding or to inhibit caking may have a marked effect, however.



Radioactive sprue bushing is fastened between two mold sections. Lead block is placed on top of exposed end of the sprue bushing to shield against gamma ray emission

To reduce radiation hazards, molded irradiated slug is removed from press with long-handled tongs. Film monitoring badge worn on operator's wrist serves as radiation detector



Lubricants Not at Fault

The lubricants evaluated, oddly enough, do not have any effect on erosion rate. They do not tend to improve the erosion characteristics of phenolic molding materials. Various lubricants have been free-blended into molding compounds in amounts of 1% with no change in erosion rate. The erosion rate of material containing blended-in lubricant is exactly the same as compound which has no extra free-blended lubricant.

The molder might naturally ask what he can do from the standpoint of molding techniques to reduce erosion. Generally speaking, erosion rate is at a minimum with the lowest possible pressures and the optimum preheat. Mold temperature does not influence erosion except as it allows lower pressures to be used in the molding operation.

As a result of preliminary work sufficient information has already been obtained to make possible formulations of molding materials which are extremely low in erosion rate. Full-scale production is expected soon. We are currently in the process of proving that the values obtained by means of radioactive tracer techniques will be borne out in actual shop practice. Even though it is too soon to say for certain, initial results indicate that the radioactive tracer technique for determining mold wear gives a true picture of actual mold wear.

Acknowledgements

The author wishes to acknowledge the valuable assistance obtained from Dr. R. S. Rochlin of the Instrument and Nuclear Radiation Section of the General Engineering Laboratory, General Electric Co., Schenectady, N. Y., in the preparation of this article.

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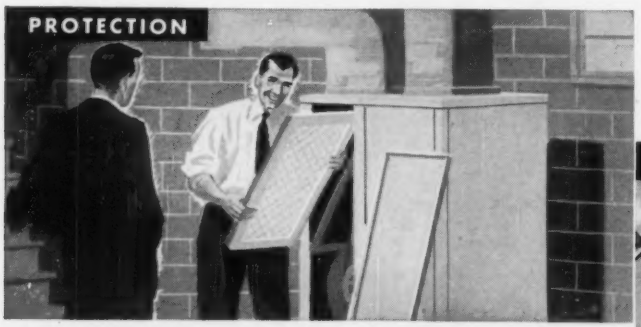

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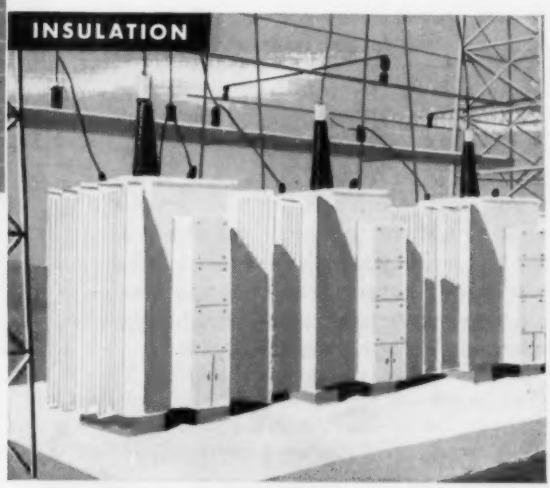

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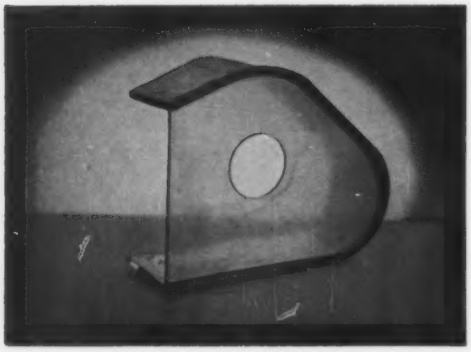

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Effects of Atomic Radiation on High Polymers

by K. H. Sun†

When atomic radiation passes through ordinary matter, the energy is dissipated largely through ionization and electronic excitation, plus a small fraction through atomic displacement and lattice disturbance, and usually an even smaller fraction through transmutation. For different kinds of radiation and different kinds of matter, the effects differ primarily in degree rather than in kind.

Since high polymers are covalent substances, the effect of radiation is largely caused by ionization and electronic excitation. These processes cause instantaneous flow of electric current and the breakage and rearrangement of chemical bonds, and the formation of free radicals. Consequently, chemical reactions are initiated. The phenomenological results include gas liberation, double-bond formation and elimination, degradation, polymerization, cross linking and vulcanization, vitrification, hydrogenation, and others. As a consequence, many important physical properties are changed.

The implications of atomic radiation are far reaching in their practical respect. Understanding of the deleterious effects has already resulted in development of high polymers that will withstand intense radiation. Studies of beneficial effects indicate that atomic radiation provides to the scientific and technical world a new experimental variable or tool unique in itself. Already, high polymers of better physical or chemical properties are produced that cannot be achieved otherwise.

THE year of the first atomic reactor, 1942, marked the beginning of a new era, one that might be called the radiation age. The impact of radiation on the technical world is being felt at an ever increasing rate. It is natural that the effects of radiation on high polymers should be of fundamental interest to the plastics and rubber industries. Even though we are only at the threshold of this new and important development, present indications lead to the belief that a study of the deleterious and beneficial effects of radiation on high polymers will open up a profitable field. The understanding of radiation damage to sealing and insulating materials is important to the technical and economical development of nuclear reactors. The cross-linking of polyethylene and other high polymers promises economic advantages in the very near future. Before discussing these developments further, it may be appropriate to review briefly the technical background which is available on atomic radiation and its interaction with matter.

Atomic Radiation

There are many different kinds of atomic radiation, just as there are many different kinds of materials. As a matter of fact, the discovery of new types of radiation or nuclear particles is still a big game for physicists today. Excellent descriptions of the various types of atomic radiation may be found in many textbooks and technical journals. It is unnecessary in the present article to go into detail about what an α-particle or a neutron is. For those who are bewildered by the wealth of literature in this field, a simple, but authoritative work, *Sourcebook on Atomic Energy*, by the AEC consultant, Samuel Glasstone, may be recommended. In brief, radiations pertinent to the present review are photons, including both γ-rays and X-rays, slow and fast neutrons, electrons, positively charged heavy particles such as protons, deuterons, or α-particles, and fission fragments. These particles (see Fig. 1, p. 142), may be made available from nuclear reactors, accelerators, or artificial or natural radioisotopes. With the exception of fission fragments, which have energies in the range 60 to 95 m.e.v. (million electron volts), they usually possess energies below 10 or 20 m.e.v. Although interactions of these various kinds of radiation with matter have received considerable attention, the fundamental principles of these effects have not been properly emphasized. Before we discuss specifically the interaction of these radiations with high polymers, let us first get a bird's-eye view of radiation interaction with matter in general.

We have mentioned important types of radiation already. They may be classified into two basic groups, namely, neutral particle radiation and charged particle radiation. The interaction of neutral particles with matter yields in most cases, as far as we are concerned, energetic charged particles. In general, therefore, it may be said that if the effect of charged particles on materials is understood that of neutral particles follows. Charged particles may be divided into negatively charged electrons and positively charged atomic nuclei or partially stripped atoms, including protons, deuterons, α-particles, and

*Reg. U. S. Pat. Off.

†Westinghouse Research Laboratories, East Pittsburgh, Pa.

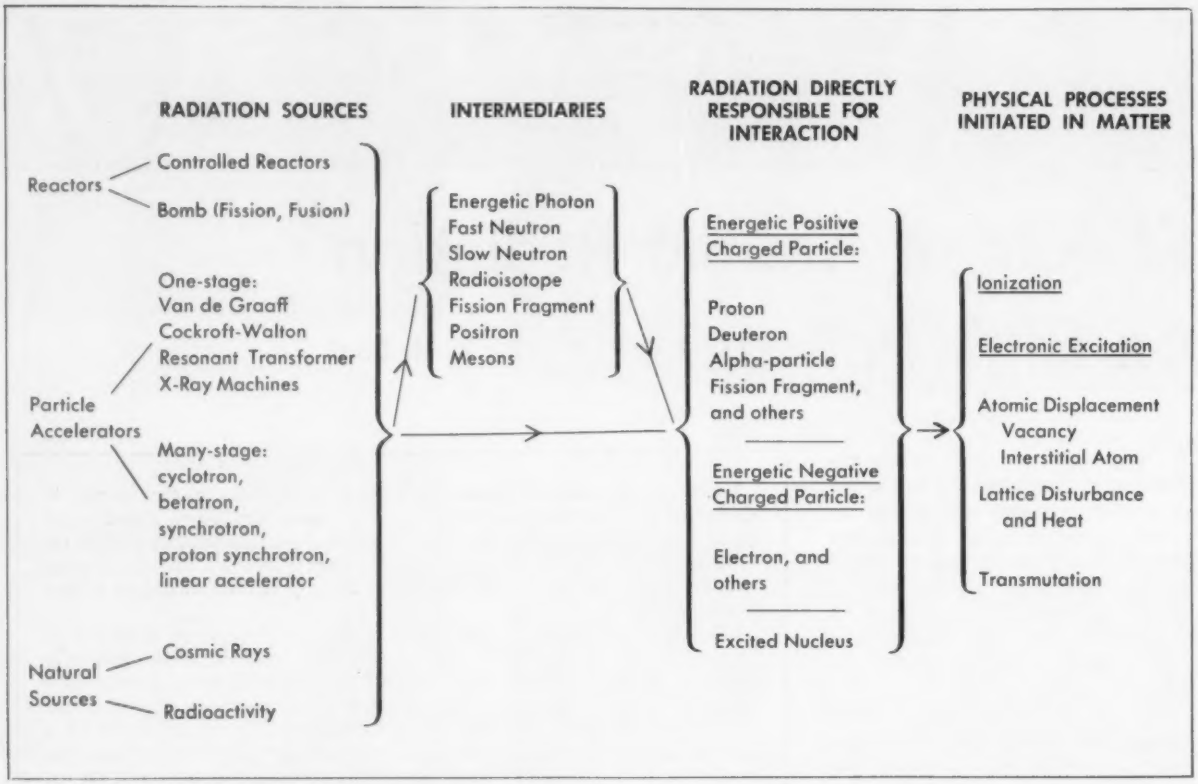


Fig. 1—Varieties of atomic radiation and their different interactions with matter

fission fragments. The radiations ultimately concerned in the study of radiation effects are thus narrowed down to only two kinds, both of which are charged particles having limited energy, even though the original agency may be a neutral particle such as a neutron or γ-ray which, however, possesses strong penetrating power.

It is now possible to discuss the generalized effect of atomic radiations on materials. The problem is reduced to the answering of the following simple question: what is the effect of electrons of 0.01 to 5 m.e.v. and positively charged particles of 0.01 to 100 m.e.v. impinging on a material, or an assembly of atomic nuclei and electron clouds? The basic effect is that the charged particle gradually loses energy to the electrons and nuclei as it passes through the assembly until all its energy is lost.

We may now ask: what are the dissipative processes? The major dissipative process involves the interaction or "collision" of the charged particle with electrons in the matter. When the energetic charged particle collides with an electron in its path, that electron may be ejected from its parent atom or molecule and *ionization* occurs. If the collision is at a glancing angle, the bound electron may gain energy without ejection and the process is called *excitation*. The average energy spent in these processes is about 25 to 35 electron volts. Thus a 3-m.e.v. electron, proton, or other charged particle can ionize or excite about 10^5 electrons in its path. These free or excited electrons may cause radical changes of physical and chemical properties of materials, resulting in the so-called radiation effect. Energetic charged particles lose over 99% of their energies by ionization and excitation processes within a given material. These processes, therefore, will be the main concern of the present review.

The energetic charged particles may also collide elastically with the positively charged atomic nuclei in matter and thus transfer energy to such nuclei. The energy transferred in the elastic collision will produce two effects. If this energy is large enough to knock the atom from its original site, *displacement* occurs. Consequently, vacancies and interstitial atoms are formed. Many metals exhibit modified properties because of displacement. The other effect is the generation of *mechanical lattice waves* or framework waves in the assembly, which eventually degenerate into thermal motion or heat. These two effects are about equal, and they both constitute a very small fraction of total energy dissipated as compared with electronic ionization and excitation. For high doses of radiation, the energetic charged particles or neutral particles such as slow or fast neutrons also cause *transmutation* of atomic nuclei and thus of atoms, which will also change the properties of materials. This effect, however, is generally small and may be neglected here.

We may summarize the above discussion as follows: The passage of various kinds of radiation through materials in effect is equivalent to the passage of either positively charged particles of high energy or energetic electrons. In

either case, the energetic particles gradually lose energy to the materials and cause ionization, electronic excitation, atomic displacement, and lattice disturbance, and, to a much lesser degree, transmutation. The first two processes consume most of the energy dissipated by the incident particle.

Penetration of Radiation

While the number of ionizations and excitations caused in materials depends primarily on the energy rather than the type of the charged particle, the particle range in materials varies widely with the type of radiation. It is thus clear that the densities of ionizations and excitations in materials produced by various radiations of equal energy are highest for those with the shortest range in the materials. While the range of energetic particles is treated in great detail elsewhere in nuclear texts, Fig. 2* gives some general idea of the range of the electron, proton, and α-particle of various energies in a high polymer having the approximate composition $(CH_2)_n$. It is clear that the electron's range is about three orders of magnitude larger than that of the α-particle. In Fig. 2, the curves for neutrons and γ-rays show the energy variation not of range but of half-value thickness, which is defined as the thickness at which neutrons or γ-rays lose half of their original intensity. It is clear that neutrons and γ-rays are extremely penetrating. The range of half-value thickness varies for different materials. It may be noted that fission fragments with energies of 65 to 95 m.e.v. have about the same range as 3.5-m.e.v. α-particles. The ionization and excitation density caused by fission fragments is, therefore, extremely high. For fission fragments, α-particles, protons, and even electrons, the effect is concentrated on the surface layers, while for neutrons and γ-rays the effect is distributed over a large volume. This is very important in visualizing the difference in distribution of radiation effect of different types of radiations. One may repeat that unless high energy electrons or protons are used, the penetration of these particles is limited as compared with γ-rays and neutrons. On the other hand, their radiation effects are much more noticeable in unit volume of materials concerned than those of γ-rays or neutrons of equal energy and intensity.

*The data used in Figure 2 are taken from the following sources:
(1) Bethe, H. A., and Ashkin, J., Passage of Radiation through Matter, a chapter in E. Segre's "Experimental Nuclear Physics," Vol. 1, John Wiley and Sons, Inc., New York (1953).
(2) Hughes, D. J., et al., Neutron Cross Sections, AECU 2040 (1952).
(3) White, G. R., X-Ray Attenuation Coefficients from 10 Kev to 100 Mev, Natl. Bur. Stands. Report 1003 (1952).
(4) Katz, L., and Penfold, A. S., Range-Energy Relations for Electrons . . ., Rev. Mod. Phys. *24*, 28 (1952).

Units of Radiation

The choice of radiation units has its difficulties in view of the various types of radiations with different energy ranges and the various types of materials involved. Basically, when radiation passes through a material, the amount of energy lost to a unit mass of the material should serve as a measure of the radiation concerned. For most practical purposes, the amount of energy associated with the ionization and excitation process has been used for the measurement. The unit based on this concept is the "rad," newly adopted by the Seventh International Congress of Radiology, Copenhagen, 1953. The rad, a unit of absorbed dose, is 100 ergs per gram. The absorbed dose of any ionizing radiation is the amount of energy imparted to matter by ionizing particles per unit mass of irradiated material at the dosage site. It is to be noted that in a constant radiation field, different materials will absorb different amounts of radiation energy per gram and, therefore, register different rad values. The rad, however, is useful because radiation effects in materials depend primarily on the energy absorbed, and the rad unit, therefore, gives a measure of these effects. More widely used is the roentgen or *r*. In simplest terms, an *r*. unit is essentially equivalent to the absorption of 83.8 ergs of energy from radiation, usually X- and γ-ray, in 1 g. of air. Naturally, for the same radiation field, the amount of energy absorbed in other materials is different. Thus 1 g. of water or tissue will absorb 93 instead of 83.8 ergs in a radiation field of 1 roentgen. In consideration of this, a very common unit named "rep" (roentgen equivalent physical) has been used up to the present. A rep is very often used as the amount of radiation energy which produces an absorption of 83.8 ergs in 1 g. of tissue or water. Since ordinary plastic is very similar to water in radiation absorption, the rep unit is very commonly used in this field and we will use it hereafter in this review. To furnish some idea of the magnitude of the *r*. unit and the dosage required for certain observable phenomena in high polymers, the following may be helpful: 1 r. is equivalent to 1.1×10^9 2-m.e.v. γ-rays/cm.^{2}, 7.2×10^8 thermal neutrons/cm.^{2}, 7.2×10^7 2-m.e.v. neutrons/cm.^{2} or 4.3×10^7 1-m.e.v. β-particles / centimeters^2. It requires about 5 mega reps to cause noticeable cross-linking in polyethylene and vulcanization of silicone rubber.

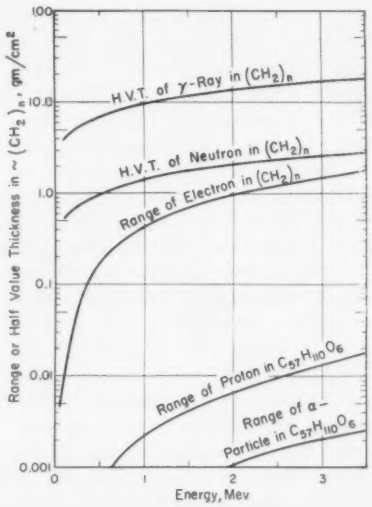


Fig. 2—Range and half value thickness of various energetic particles in ~$(CH_2)_n$

Radiation Sources

There are several important types of irradiation facilities available today. The types of radiations obtainable from them are not of primary concern since there are ultimately produced electronic ionizations and excitations which are responsible for the radiation effects in high polymers. The strength of radiation field and depth of penetration, however, do depend on the types of radiation sources used. These constitute the governing factors in selecting the sources for irradiation. Most of the facilities available today are good only for laboratory uses. These are briefly as follows:

1. **γ-Rays:**
   a. *Co^{60}-source*—This is the most

commonly used today, and is usually available in 1 to 10 kilocuries strength. The cobalt is usually arranged by an accessory structure in the form of a hollow cylinder, with an inside diameter ranging from 2 to 6 in. and a length in the neighborhood of 12 inches. The radiation field inside the cylinder is about 0.1 to 1×10^6 r./hour. The source decays to half its initial strength in about 5.3 years. These sources are available in many laboratories including Brookhaven, Oak Ridge, Argonne, Michigan, Yale, Stanford, MIT, General Electric, and the Naval Research Laboratory.

b. *U-fuel slugs*—Burnt uranium slugs from reactors are usually dumped into a deep water canal to "cool." These slugs may be arranged to give a uniform γ-ray field above or inside the submerged fuel element assembly. Public facilities for such irradiation are available at the AEC Materials Testing Reactor and the American Cyanamid Co., as well as other places outside the United States. The radiation field varies with strength and age of the fuel elements. It generally ranges from 5×10^3 to 5×10^7 r./hour.

c. *Fission by-products*—These may include waste solutions, separated isotopes such as Cs^{137}, or gaseous fission products liberated from a homogeneous reactor. Although much discussion and thought has been concerned with the use of fission by-products for irradiation, very few practical sources have made their appearance as of today. The Argonne National Laboratory, however, recently has made available an experimental source that was produced by mixing 2 kilocuries of 1 yr. old fission waste solution with cement to form a hollow concrete cylinder. The radiation field is about 10^4 r./hour. However, high-intensity irradiation facilities from fission by-products may be expected in the future.

2. Electrons—These are powerful ionizing agents as compared with γ-rays. Although there are various types of machines, such as betatrons, linear accelerators, resonant transformers, etc., to produce higher energy electrons from 0.8 m.e.v. up, one of the most practical sources for general application today is the modern Van de Graaff generator. A typical model provides a 250-μamp. 2-m.e.v. electron beam in an area approximately 1 by 15 cm. and a depth of penetration of about 1 cm. in high polymers of unit density. It is possible to deliver a radiation dose of the order of 4×10^6 rep in 1 sec. or about 10^{10} rep in 1 hour. In specially designed machines, the dose rates can be increased considerably. The main limitation of the electron beam is its restricted depth of penetration.

Although artificial beta sources are sometimes used for irradiation purposes, they are not convenient and give relatively low intensity. A 2-m.e.v. beta source of 1 curie per $cm.^2$ would give a radiation dose of only about 3 mega rep/hour.

3. Neutrons and γ-rays—Irradiation services in reactors are available at Brookhaven, Oak Ridge, the Material Testing Reactor at Idaho, and other places. The thermal neutron flux varies from 10^{11} to 4×10^{14} neutrons/$cm.^2$/sec. and is accompanied by fast neutrons and γ-rays. The radiation field is roughly in the order of 10^5 to 10^9 r./hr., which is lower than that from electron beams of a most powerful modern Van de Graaff Machine. The sample to be irradiated is usually in the form of a cylinder of a few inches length and from ¾ to several inches diameter. In addition to electronic ionization and excitations, two other effects may be noted in reactor irradiated samples. If the sample contains high neutron capture atoms, it will become radioactive. For high polymers in general, the radioactivities are either short lived or relatively weak. In addition, the fast neutrons will cause displacement of atoms more severely than electron irradiation.

4. X-rays—For laboratories that do not have easy access to modern nuclear machinery or high intensity radioisotopes, it may be noted that the ordinary X-ray machine is capable of delivering a radiation field comparable to or larger than that from kilocurie radioactive Co^{60} sources. For example, an industrial X-ray machine running at 200 kv. and 10 ma. is capable of delivering 4×10^5 r./hr. over a 2-in. diameter near the window of the tube. Using Be windows, some X-ray tubes are capable of delivering 10^8 mega r./hr. in ordinary plastic of 1 mm. thickness. Since X-rays are produced from electrons rather inefficiently, it would seem uneconomical to use X-rays instead of electrons. However, high-voltage X-rays have the special advantage that their depth of penetration in a given material is much higher. This is also true for γ-rays.

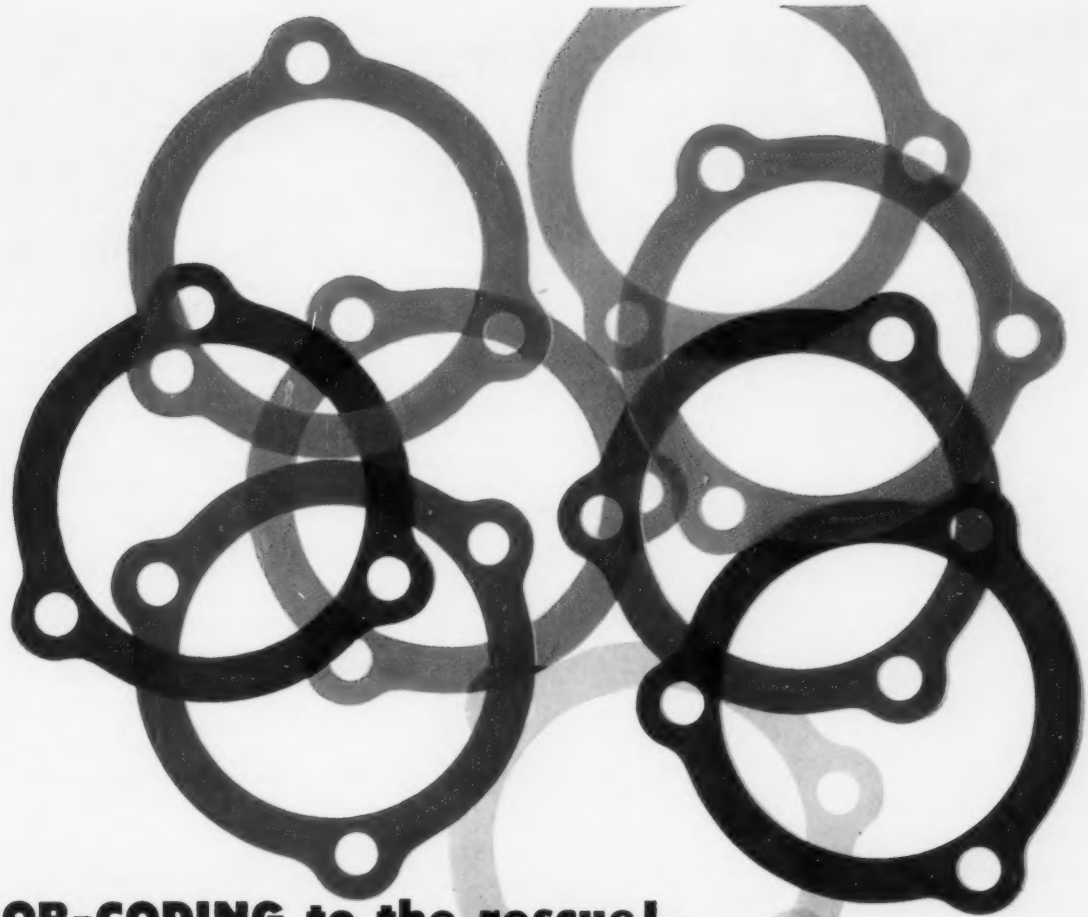
5. Protons, deuterons, α-particles, fission fragments—These particles from modern cyclotrons or other nuclear machines are capable of producing much higher radiation doses in thin sections of materials than any of the other sources mentioned above. At the University of Pittsburgh cyclotron, for example, it is easy to get 10^{12} rad/hr. for a thin section by using its 16-m.e.v. deuteron beam. At such an intensity the sample becomes so hot that it is difficult to control its temperature. For fission fragments, ionization density per incident particle is highest of all. Under such conditions, phenomena not common to other radiations may be expected.

Physicochemical Changes

Earlier it has been indicated that when atomic radiations pass through materials, a large fraction of energy is dissipated through ionization and electronic excitation. In general, these processes lead to physicochemical changes which result in changes of physical properties. All the phenomena in which we are interested at present are, therefore, limited to this phase of radiation effect. The discussion is usually in the realm of radiation chemistry. Once the physicochemical processes are understood, the changes of physical properties of substances may be predicted from our knowledge of the correlation between physical properties and chemical constitution.

It is known that the amount of energy dissipated in ionization is about the same as that dissipated in electronic excitation. The number of atoms and molecules excited is about 1.3 times that ionized. The processes of excitation and ionization of a molecule usually lead to one or more of the following processes: 1) the breaking of chemical bonds and the formation of free radicals, 2) the dissociation or degradation of the molecule, 3) rearrangement of the molecule, and 4) instantaneous conduction of electric current during irradiation.

Let us see how these processes affect high polymers. For simplicity,



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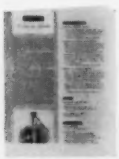

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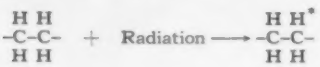
we assume that high polymers are composed of long and branched chains represented by the formula, $(-CH_2-)_n$. The basic processes that occur during ionization and excitation, which finally lead to the various types of chemical changes, are as follows:

1. Formation of ionized molecules:

2. Formation of excited molecules:



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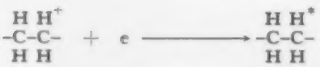


3. Direct degradation of ionized molecules:

$$C_2H_6^+ \longrightarrow C_2H_4^+ + H_2,$$

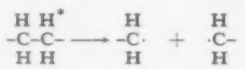
$$C_4H_{10}^+ \longrightarrow C_2H_6^+ + CH_4, \text{ etc.}$$

These have been experimentally observed. Note that the degradation products are hydrogen and lower hydrocarbons.

4. Molecular rearrangement of excited molecules:

Straight chain→Branched chain, etc.

5. Decomposition of excited and ionized molecules and formation of free radicals:



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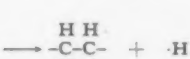

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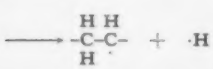
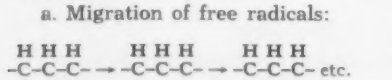


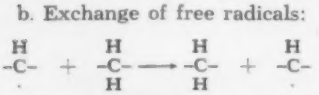
Thus, not only free hydrogen atoms and carbon-containing free radicals are formed, but the long chain is also severed.

6. Free radical reactions:

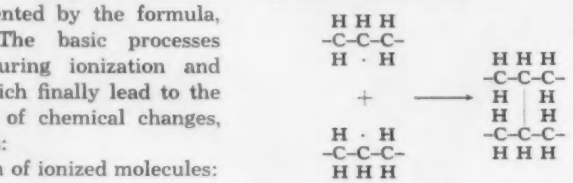
a. Migration of free radicals:



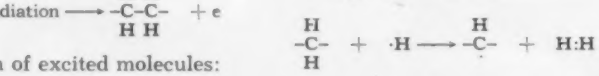
b. Exchange of free radicals:



c. Recombination leading to polymerization or cross linking of hydrocarbon radicals:

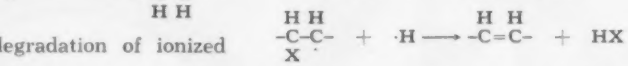


d. Hydrogen formation:

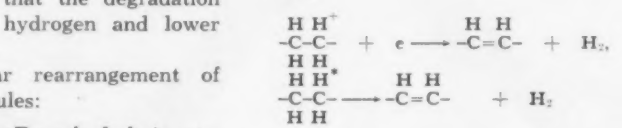


In this way the free hydrogen atoms formed from the excited or ionized molecules react with the hydrocarbon chains to form carbons containing free radicals and hydrogen gas.

e. Double bond formation:



X may be H, F, Cl, etc. A gaseous product is formed in this process. A double bond may be formed from ionized or excited molecules directly:



f. Hydrogenation and double bond elimination. The presence of atomic hydrogen should cause hydrogenation to occur when possible. For example:

In this case, not only a double bond is broken, but the position of the unpaired electron is shifted. A similar type of reaction has been reported by Dole.

From the above illustrations, and perhaps others, it is clear that the passage of radiation through high polymers may result in one or more of the following processes: formation of hydrogen, lower hydrocarbons, and other gases, degradation, polymerization, cross-linking including vulcanization, double bond formation or elimination, hydrogenation, etc. All of these processes have been observed. They lead directly to changes of physical properties.

Phenomenological Changes

From previous discussions, it is obvious that certain common phenomena will be observed in high polymers after the passage of radiation. Various types of radiations and high polymers will yield results different only in degree rather than in kind.

Although in the past there were a few incidental studies of radiation effects on high polymers, intensive investigations began only after the invention of the nuclear reactor. Since plastic insulators, gaskets, shields, containers, optical parts, etc. are used in reactors, any damaging effect by radiation is obviously important. The utilization of radiation to improve properties of high polymers was also an aim clearly realized in the minds of early workers. Among the significant investigations is the one by Sisman and Bopp, who measured the irradiation effects on specific gravity, weight change, water absorption, light transmission and haze, percent elongation, tensile strength, stress-strain elastic modulus, impact strength, shear strength, Rockwell hardness, volume resistivity, dielectric strength, and arc resistance for the following types of high polymers: acrylic (Lucite), amino (urea-formaldehyde, melamine-formaldehyde, aniline-formaldehyde), casein (Ameroid), cellulosics (ethyl cellulose, cellulose propionate, cellulose acetate, cellulose nitrate, cellulose acetate butyrate), ethylene and fluoroethylene (polyethylene, polymonochlorotrifluoroethylene, polytetrafluoroethylene), furan (furfuryl alcohol), nylon, phenolics (mineral filler, cellulosic filler, no filler), polyester (allyl diglycol carbonate and others), styrene, and vinyl (polyvinyl carbazole, vinyl-vinylidene chloride, vinyl chloride acetate). Additional basic work has been carried out recently by Charlesby and many others.

We shall briefly discuss the phenomenological changes brought forth by radiation. At this stage, it is not possible to present a clear and coherent picture of these changes for all high polymers. Therefore, we choose, in general, polyethylene as a typical example, though other high polymers are also discussed. Phenomenological changes may be divided into two groups, namely, primary changes that are rather closely connected with the basic physicochemical changes, and secondary changes that are the result

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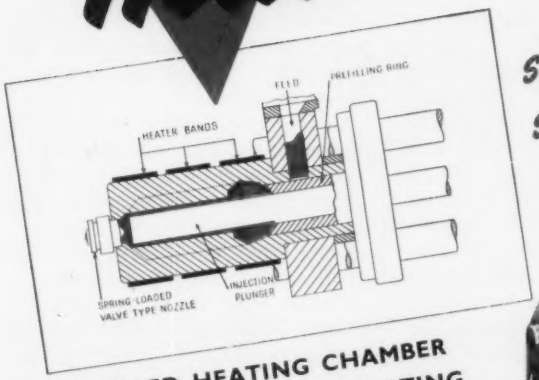

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Pressure per square inch on material at end of plunger	9,100 lb.
Total pressure on Injection plunger	18,850 lb.
Mold opens (adjustable)	6—9 in.
Maximum die space	7½ in.
Minimum die space	3½ in.
Maximum recommended casting area in mold	15 sq. in.
Size of die plates	16 x 10 in.

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of the primary changes. The division of primary and secondary changes is for purposes of discussion and should be considered as rather arbitrary.

Primary Changes

Gas formation—As mentioned previously, hydrogen, lower hydrocarbons, and other gases can be formed in irradiating high polymers. This has been observed experimentally. It is interesting to note that whether the bombarding agency is electron, deuteron, α-article, or pile radiation and whether the polymer bombarded is polyethylene, paraffin, or other hydrocarbon, over 94% of the gas liberated is hydrogen, the rest being hydrocarbons such as methane, ethane, propane, butane, etc. This has been substantiated by Dole, Charlesby, Allen, and others. Charlesby also found that the amount of hydrogen observed is about 0.7 mg. per g. polyethylene per 1 C* unit of radiation.

For polytetrafluoroethylene, using Co^{60}, Ryan found the following relationship for the liberation of fluorine by radiation:

$$X = 3.78 \times 10^{-7}\ Y^{1.15}$$

where X is micrograms of fluorine liberated per gram of Teflon, and Y the radiation dosage in roentgens. Byrns et al. found the rate of halogen evolution to be about 7 millimoles per gram of Kel-F or polyvinyl chloride per billon r. of Co^{60} — γ exposure. Charlesby observed that the minimum radiation required for incipient bubbling in methyl methacrylate depends on the temperature. At 70° C., it is about 2 C units.

Double bond formation—Dole reported that when polyethylene is irradiated *in vacuo*, an infra-red absorption peak at 10.4 μ was observed, which may be attributed to the formation of a vinylene group. Irradiated polyethylene also takes up bromine. Ryan also found two infra-red absorption bands for Teflon irradiated to 10^9 rep at 5.7 and 6.5 μ, which could be attributed to

$$\begin{matrix} F & F \\ | & | \\ -C=C- \end{matrix} \quad \text{and} \quad \begin{matrix} F & F \\ | & | \\ -C=CF. \end{matrix}$$

Oxidation—The effect of oxidation during irradiation has been noted by Little, Sisman and Bopp, Dole, Charlesby, Ballantine et al., and others. In the case of irradiated polyethylene, all the investigators report an increase in weight in air due to oxygen absorption. No weight increase is observed *in vacuo*. On further irradiation, polyethylene and other plastics lose weight because of gas formation. The wax-like surface film formed due to oxidation on polyethylene is readily revealed through ultra-violet fluorescence. After 26 C units of irradiation, Charlesby noted that the surface has the empirical chemical formula of $(C_3H_5O)_n$ instead of the original $(CH_2)_n$. Dole and Ballantine et al. have actually identified the formation of carbonyl (ester, formate, propionate) and hydroxyl groups through infra-red absorption study of irradiated polyethylene film. The absorption peaks are 5.85 μ and 2.9 μ, respectively. All this indicates that irradiation in air strongly oxidizes the exposed surfaces of the hydrocarbon high polymers under investigation.

Cross-linking—The cross-linking effect by irradiation was noted by Little, Dole, Charlesby, and others. Cross-linking converts a high polymer from thermoplastic to thermosetting, or from plastic to elastic. Vulcanization of rubber is a process which involves a special type of cross-linking.

Insolubility and resistance to melting are definitely an indication of cross-linking between polymer chains. For polyethylene, Charlesby found that 0.05 C units irradiation are capable of producing one cross-link per molecule of polyethylene, hence a giant molecule is formed. For paraffin, the dose is larger in inverse proportion to the molecular weight. Lawton, Bueche, and Balwit found that some high polymers are cross-linked while others are degraded. The following is a list of high polymers that become cross-linked by irradiation: polyacrylic esters, polystyrene, polyesters, nylon, chlorinated polyethylene, chlorosulfonated polyethylene, natural rubber, GRS, butadiene-acrylonitrile copolymers, neoprene-W, neoprene-GN, polydimethylsiloxanes, and styrene-acrylonitrile copolymers. As already indicated, the efficiency of irradiation varies from one polymer to another. Nylon and polydimethylsiloxane behave similarly to polyethylene. All workers indicate that the dosage of radiation required for cross-linking varies inversely with the molecular weight of the high polymer. Lawton, Balwit, and Bueche found that in the range of irradiation dose up to 200 mega rep, each ion pair produces 0.6 to 2.6 cross-links. It is reasonable to expect that a large amount of work in the future will be devoted to the investigation of this particularly interesting phase of radiation effect.

Among the typical cross-linking processes is the vulcanization of rubber. Davidson and Geib noted a slight curing action of pile irradiation on natural rubber. Charlesby showed that the degree of cross-linking is directly proportional to radiation dose. It has been demonstrated that 1 C unit produces one cross-link per 90 isoprene units.

With high dosages, say 100 mega rep, the cross-linkages in rubber hinder the uncoiling and slipping of chains, and the rubber becomes hard and brittle; the damage effect of exposure to atomic radiation has set in.

Polymerization—The fact that organic compounds can be polymerized by ultra-violet rays and other radiation has been known for a long time. Since the birth of reactors, more work has been done on polymerization by radiation than on other radiation effects. The process of polymerization by radiation has been shown by various workers to be caused by the free radicals formed. In an ordinary process of polymerization, the free radicals are usually produced by the addition of a catalyst. In the case of radiation induced polymerization, free radicals are formed without the catalyst. The chain reaction then propagates and continues to its termination as it does in a conventional process.

Ballantine and Manowitz studied the polymerization mechanism of styrene and methyl methacrylate with γ-rays. Both monomers show a constant rate of polymerization in the initial stages followed by a rapid increase. The turning point for the rapid rate increase occurs at about 140, 22, and 7 mega rep for styrene at —18°, 25°, and 72° C., respectively. Molecular weight increase and rise of temperature also occur with

*One C unit is arbitrarily defined as equivalent to 10^{17} thermal neutrons/cm.^{2} with the associated fast neutrons and gamma rays at the center of the BEPO (a British graphite research reactor). A C unit is estimated as equivalent to about 50 mega roentgens.

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the increased rate of polymerization. The activation energy of the process was found to be 6700 cal. per mole. The yield of polymer at 72° C. is estimated to be about 10 and 84% per mega rep for styrene and methyl methacrylate, respectively. The workers at the Brookhaven National Laboratory also noted that the initiation of polymerization for acrylamide by γ-rays can be delayed for days in a refrigerator. When the irradiated monomer is warmed to room temperature, the polymerization rate increases rapidly and the sample temperature rises above the melting point.

Schmitz and Lawton polymerized acrylates, methacrylates, styrene, and acrylonitrile with 800-k.e.v. electron beams. Difunctional vinyl monomers, such as tetraethyleneglycol dimethacrylate, polymerize much more readily than monomers containing only one double bond. This last named compound polymerizes to a solid with 2.5 mega rep. The same amount of radiation produces only 1% polymerization in methyl methacrylate. About 10^{18} free radicals are formed per mega rep in 1 g of tetraethyleneglycol dimethacrylate. Polymerization is found to occur at a temperature as low as −55° C. Delayed polymerization by cold storage was also found by these workers.

Hobbs and his associates at Michigan noted that the copolymerization of styrene and methyl methacrylate induced by 10 mega rep Co^{60} γ-rays bears resemblance to reactions catalyzed by benzoyl peroxide. Bretton and his associates have carried out an extensive study on the polymerization of C_2H_2 and C_2H_4 by Co^{60}—γ irradiation under various temperatures, pressures, and other experimental conditions. In the case of C_2H_2, the number of reacting molecules observed per ion pair is about 20, indicating a chain type mechanism. The surface of the reaction vessel plays an important role in chain breaking. Martin and his associates also studied in detail the polymerization of ethylene and propylene under γ-radiation. Collinson and Dainton, by polymerizing acrylonitrile in D_2O with X- and γ-rays, obtained direct proof of the formation of D atoms in the irradiated liquid, and confirmed the participation of D atoms in the polymerization. Berstein et al. studied polymerization of acrylonitrile as a function of radiation dose. Manion and Burton, and Patrick and Burton have polymerized benzene with 1.5-m.e.v. electrons to a non-volatile compound of molecular weight approximately 530. Seitzer et al. also investigated polymerization by β-rays from Sr^{90}—Y^{90}, and found that 0.2 and 2.3% of the absorbed radiation energy is effective in producing initiating radicals in styrene and methyl methacrylate, respectively. The efficiency is obviously very low. Landler and Magat used slow neutrons to polymerize a mixture of 80% styrene and 20% ethyl bromide. The latter is introduced to capture neutrons, forming radioactive bromine. Free radicals are formed through the Szilard-Chalmers reaction. This way of introducing radiation is rather novel. Chapiro also studied similar processes in detail.

Degradation—At high doses all high polymers degrade. The basic process causing degradation is the scission of chemical bonds. For many polymers, degradation begins to be of considerable magnitude even while other polymers are still benefited. Teflon and polyvinyl chloride are typical examples of easily degraded polymers. Even in the case of polyethylene, Dole reported that the ratio of CH_3/CH_2 is increased for the vacuum-irradiated sample. This is an indication of scission. Lawton et al. investigated the degradation of cellulose from wood into soluble sugar. At 330 mega rep, cellulose becomes completely soluble. Other polymers that degrade upon irradiation are vinylidene chloride, isobutylene, methyl methacrylate, and chlorotrifluoroethylene. Wall and Magat studied the kinetics of degradation of styrene and methyl methacrylate with Br-containing copolymers.

Fluorescence—When polyethylene, polymethyl methacrylate, nylon, and polyvinyl chloride are irradiated with 2-m.e.v. electrons, a bright bluish-white fluorescence results, as observed by Sheppard and Sun. The fluorescence of polyvinyl chloride dims, however, on further irradiation and completely stops at about 16 mega rep.

Conductivity during irradiation—Farmer and Mayburg, and Lawrence observed that the electrical conductivity during irradiation of high polymers, such as polyethylene, is many orders of magnitude higher than that before or after irradiation. Mayburg and Lawrence believe that the conduction is probably due to ionic protons rather than electrons. McClinton et al. have carried out a large number of electrical measurements on high polymers during irradiation at the Naval Research Laboratory.

Crystallinity and vitrification—The degree of crystallinity of a high polymer may be estimated from measurements of density, heat of fusion, intensity of X-ray diffraction pattern, infra-red absorption band, and nuclear magnetic resonance. From the density measurement Charlesby was able to deduce the percentage of crystallinity of irradiated polyethylene and thus to correlate the percentage of crystallinity with degree of cross-linking. Roughly, the degree of crystallinity decreases from about 50% to near zero as cross-linking by radiation increases from 0 to 28 percent. While the degree of crystallinity is reduced by radiation, the temperature at which the crystallinity vanishes is not greatly affected. For highly cross-linked polyethylene, an X-ray pattern identical with that of liquid polyethylene, with halos at 2.2 and 4.6 A., is obtained. Charlesby, however, observed that cross-links can occur within a crystallite without considerable distortion of the relative position of the aggregates.

Chemical effects—The presence of benzene or other aromatic ring in a high polymer increases its resistance to radiation. Little, for example, found that gas formation in polyethylene terephthalate is negligible as compared with that in nylon, indicating the protecting action of the benzene ring. Ross and Charlesby actually added various aromatic ring compounds in polymethyl methacrylate to reduce the degradation by radiation. The most convincing evidence is the energy required for cross-linking as noted by Charlesby. For aliphatic hydrocarbons, from heptane to polyethylene, the energy per cross-link is only 22 electron volts. This figure is to be compared with the corresponding value of 3000 to 5000 e.v. for polystyrene where the benzene ring is present. Apparently, the benzene ring is able to absorb the

(*To page* 229)

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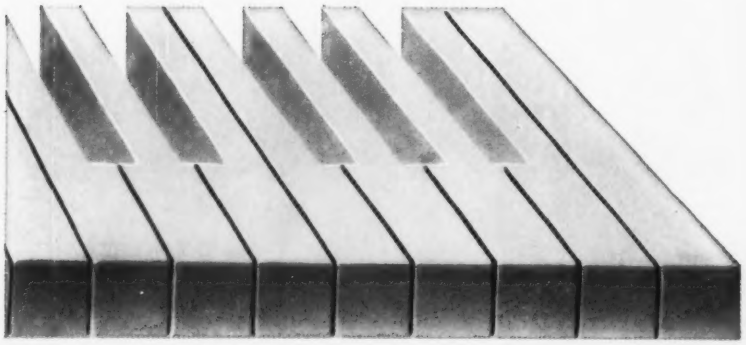

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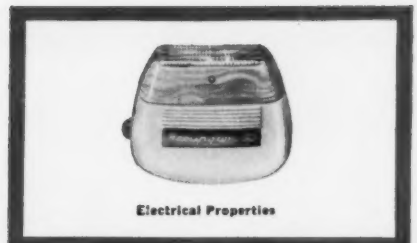
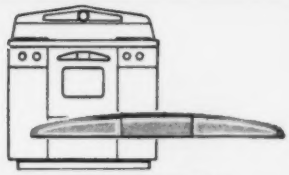


Electrical Properties



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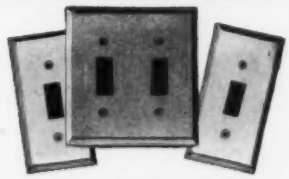

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Alloying With Epoxies

by John Charlton*

EPOXY resins arrived commercially only a few years ago, but in this short time they have become a major resin class. The resins, in their own right, have many desirable properties and are used unmodified for coatings, castings, laminates, and adhesives. They have a wide range of compatibility, and they can impart some of their good qualities to many other resins. They also have some shortcomings in specific instances and can frequently be improved by the addition of other resins. These two reasons have been the driving force behind the work that has been done in the last year or two toward producing many new combinations of epoxy resins with other plastic materials. These combinations form the subject of this paper; we have called them "alloys," a new word for the plastics engineer.

We have chosen the word alloying to describe what epoxies can do for other resins, because any other word has too limited a meaning. Epoxy resins are capable of a great many reactions and can, of themselves, be so varied that they show a wide range of compatibility and reactivity with other resins. The word alloy, therefore, can be used to designate materials that may be copolymers of epoxy and other resin-forming compounds or products of reactions with other resins, or both, just as in metallurgy the word alloy refers to inter-metallic compounds as well as metallic mixtures of various kinds.

Until recently, the makers of epoxy resins have been so busy trying to catch up with demand for the run-of-the-mill epoxies that they have not been able to evaluate the possibilities of using them in modifying other resins. We are now beginning to catch up with demand, and the results of much preliminary investigation that has been taking place in laboratories are being reported. Some of this work, particularly in the coatings field, is already well known. For example, epoxy-oil esters, epoxy-ureas, epoxy-phenolics, and epoxy-melamines are used extensively. A search of the patent literature shows many more combinations, such as with vinyls, polyamides, acrylonitriles, Thiokol[1], isocyanates, styrenes, rubbers, and many other compounds. Many of these alloys are in such an early

*Ciba Co., Inc.

[1]Tradename of Thiokol Chemical Corp.

EPOXY ALLOYS CHART

Alloy	*Typical Comm'l. Material*	*Uses*				*Outstanding Properties*	*Typical Application*
		Adhesives	*Coatings*	*Laminates*	*Potting*		
Epoxy-fatty acid ester	Soybean fatty acid, Dymerex (Hercules Powder Company)		X			Air drying; chemical resistance; low cost	General purpose enamels
Epoxy-styrene	Monomeric styrene		X			Outdoor durability; alkali resistance	Quick dry enamels
Epoxy-urea	Uformite (Rohm & Haas), Beckamine (Reichhold)		X			Good color; chemical resistance	Appliance finishes
Epoxy-phenolic	Methylon (G.E.) Resinox (Monsanto)	X	X	X	X	Low cost; flexibility; excellent chemical resistance; heat resistance	Drum liners
Epoxy-melamine	Resimene (Monsanto)		X	X		Heat & chemical resistance	Collapsible tube linings
Epoxy-polyamide	Polyamide (General Mills)	X	X	X	X	Clarity; flexibility; chemical resistance; rapid cure	Paper coating
Epoxy-vinyl	Butvar (Monsanto) Vinylite (Bakelite)		X			Color; chemical resistance	Wire coating
Epoxy-furan	Furan (Furane Plastics)		X	X		Heat resistance; excellent chemical resistance	Special requirements
Epoxy-Thiokol	Thiokol (Thiokol Chemical)	X	X	X	X	Low temperature resistance; flexibility; chemical resistance	Fuel tank linings; pressure bottles
Epoxy-polyester	Paraplex (Rohm & Haas)	X		X	X	Working properties; cost	
Epoxy-oil	Acme Star (Acme Wire)				X	Resilient; good electrical properties	Electronic encapsulating
Epoxy-asphalt	———				X	Low cost	Asbestos-felt impregnant

state of development that opinions may differ about their possibilities, but the fact that so many patents exist is solid proof that many competent people have done considerable work producing and evaluating the combinations that are to be described below.

Epoxy resins, are, themselves, many. If we use the broad generalization that any compound with an epoxide linkage is an epoxy resin, then the possibilities are almost unlimited. Fortunately, the number is whittled down by the availability and cost of raw materials to those that are derived from epichlorohydrin, a commercial diol such as "bis-phenol A," and a long chain aliphatic diol. The list of patents at the end of this article shows that other possibilities are being actively investigated, but, aside from one or two based on cashew nut oil derivatives or cyclopentadiene, they are not used in alloying.

Epoxies in Coatings

It is only natural that epoxy-alloys should have been developed in the coatings industry first. The people in this industry are old hands at blending, reacting, and copolymerizing, and have developed means of testing the results rapidly. There are alloys of epoxies with melamines, vinyls, and polyesters as well as the earlier drying oil esters and urea-phenolic compounds. We now have the following coatings being presented commercially by various organizations or reported in the patent literature:

Epoxy-Fatty Acid Esters—Epoxy esters were originally developed to reduce the initial high cost of the epoxy resin and to provide air-drying formulations with good chemical properties. The hydroxyl and epoxy groups will react with acids under the influence of heat, and long chain fatty acids are of particular value. The reaction product, therefore, is similar to an alkyd resin but has an inherent superiority because of the chemical resistance and adhesion of the epoxy resin. The major alloys in use today are the fatty acid esters, rosin, rosin acids, rosin esters, and tall oils.

Epoxy-Styrene—Styrenated epoxy esters are also being made at present because they show exceptional outdoor durability and chemical resistance. They are analogous to styrenated alkyds, but superior in outdoor durability. A typical formulation of this type is taken from a Shell Chemical Co. bulletin on Epon coatings:

Epon 1004	30.0% by wt.
Soy bean fatty acids	29.3
Dehydrated castor acids	7.4
Styrene	33.3

Epoxy-Urea—Epoxy-urea systems have shown marked superiority where chemical resistance and good color are required. Urea resins such as Beckamine (Reichhold Chemical Co.) and Uformite F-210 (Rohm and Haas Co.) have been used in formulations with epoxy resins for appliance finishes.

Table I—Properties of Polyester-Epoxy Resin

Pot life: 3 to 4 days at 20° C.	
Cure time: 20 to 30 hr. at 120° C.	
Tensile strength: 5000 p.s.i.	
Modulus of elasticity: 400,000 p.s.i.	
Compressive strength: 17,000 p.s.i.	
Heat resistance (Martens): 116° C.	
Decomposition point: 320° C.	
Dielectric constant at 20° C.	
10^2 cy.	4.05
10^4 cy.	3.92
10^6 cy.	3.69
Dissipation factor at 25° C.	
10^2 cy.	0.010
10^4 cy.	0.014
10^6 cy.	0.027

Epoxy-Phenolic—Several phenolic resins, such as Methylon 75109 (General Electric Co.), are being manufactured for blending with epoxy resins. A typical formulation for a phenolic-epoxy resin is the following:

Monsanto P97 (Monsanto Chemical Co.)	30 parts by wt.
Araldite KD-331 (Ciba Co., Inc.)	53
Toluene	55
Methyl isobutyl ketone	55

Epoxy-Melamine—Coatings based upon epoxy-melamine mixtures exhibit high chemical and heat resistance compared with the pure epoxy. They have been outstandingly successful as internal liners for collapsible tubes and milk containers. Many formulations for epoxy-melamine resins are reported in U.S. Patent 2,458,796, and some of these are now in use in this country and in Europe.

Epoxy-Polyamide—One of the newest developments is an epoxy polyamide formulation which has found considerable interest as a coating for collapsible tubes, paper, rubber, and metals. The product has better clarity than straight epoxy resins, improved flexibility, and good chemical resistance. A typical paper coating is presented by General Mills, Inc. in their polyamide brochure as a formulation made up of the following components:

Solution A	
Polyamide resin #100 (General Mills, Inc.)	50 parts by wt.
Toluene	25
Isopropanol	25
Solution B	
Araldite EN-5001 (Ciba Co., Inc.)	50
Toluene	25
Methyl ethyl ketone	25
Diluent	
Toluene	50
Isopropanol	25
Methyl ethyl ketone	25

Epoxy-Vinyl—Several epoxy-vinyl alloys for coating have been produced recently. Vinyls improve the chemical resistance and color of epoxy films and also improve the flow of epoxy-phenolic alloys. The vinyl resin reduces heat resistance and adhesion to metals, and for this reason generally is used as the minor constituent. Epoxy resins are also used as stabilizers in vinyl unsupported films, and this field absorbs a considerable amount of epoxy resin such as Araldite CN-503 or Epon 834. An example of the use of a vinyl butyral resin (Butvar[2]) as a flow control agent is Shell's formulation YP-100, which is actually an epoxy-phenolic-vinyl alloy. A formulation that uses vinyl resin in important amounts is an extremely successful coating for paper, recommended by General Mills, Inc. It is a ternary alloy of epoxy resin (Araldite CN-501), polyamide resin

[2]Tradename of Shawinigan Products Corp.

(General Mills 100), and a vinyl resin (Vinylite[3] VAGH).

An interesting epoxy-styrene-acrylic alloy is reported in U. S. Patent 2,662,870. It uses vinyl piperidine as a catalyst. This idea also bears further watching and is a good example of the ability to modify an epoxy with a resinous catalyst.

Epoxy-Furan—Epoxy-furan resins have become important recently through the work of Furane Plastics, Inc. Furan resins introduce improved heat resistance and outstanding chemical resistance, even better than the epoxies themselves. This is especially true where strong acids, ketone solvents, and methanol are the exposure media. The epoxies contribute adhesion, flexibility, and toughness. Therefore, these alloys are being studied as candidates for can and drum liners. A resin of this type has been used in contact with concentrated hydrochloric acid at high temperatures for over a year. It has also been used in paper mill digester linings for over 6 months.

Future Coating Developments—Almost all the formulations developed today call for the use of an epoxy resin based upon a bisphenol-epichlorohydrin resin, although minor amounts of a glycerol-based resin are also used. It seems certain that before long other aliphatic based resins will be used in coatings. The raw materials are cheaper, and the resins could be cheaper if the yields are good. They could also provide better color and greater solubility in cheap solvents. The outstanding weaknesses of aliphatic epoxy resins are low moisture resistance and attack by compounds with active hydroxyl groups, but it is certain that new epoxy alloys will be developed to reduce these problems. One particularly interesting idea is that of producing water-soluble polymers by starting with the right diol. The production of such resin would open several new fields of activity, such as alloying with latex for water-base paints, or in textile finishing in combination with melamines and other resin emulsions.

Adhesive Alloys

Upon looking at the patent literature one would believe that whenever a chemist mixes an epoxy resin with any other, he calls the result an adhesive. The reasons for the great diversity of adhesive formulations are the very dissimilar requirements for performance that occur because of the many places where adhesives can be used, the wide compatibility of epoxies, and the ability to bond to most materials. The literature reports combinations of epoxies with almost everything. Isocyanates, polyesters, rubbers, phenolics, resorcinols, and polyamides form the bulk of the commercial adhesive alloys. Epoxy adhesives are primarily metal adhesives, and other resins are alloyed with them to impart some characteristic lacking in the unmodified adhesive.

Phenolic resins contribute improved heat distortion and strength at high temperatures. Acrylonitrile gives flexibility and improved peel strength, and polyamides produce flexible adhesives with better working properties. It is characteristic of adhesive manufacturers that they do not publish the composition of their products beyond the statement that they are epoxy-polyamide, epoxy-phenolic, etc., as the case may be. There are many adhesive manufacturers who supply these alloyed adhesives, and the following are only a few of them:

Armstrong Adhesives, Warsaw, Ind.
The Borden Co., New York, N.Y.
Houghton Laboratories, Inc., Olean, N.Y.
Lawrence Adhesives, Lawrence, Mass.
Polymer Corp., Springdale, Conn.
Rubber & Asbestos Corp., Bloomfield, N.J.

It is hard to forecast what alloying will take place in the future with epoxy adhesives because the resins are undergoing a distinct change to provide, within themselves, increased strength at high temperatures. Attempts in this direction have been made towards improving the cross-linking of the epoxy resins with new catalysts such as meta-phenylenediamine or ortho-phenylenediamine. The result tends to make the epoxy resin brittle for adhesive users. Hence, it may well require the addition of plasticizing agents to improve the peel strength, much as phenolic adhesives are modified with vinyl resins to provide better peel. There is little doubt, however, that polyester resins will be alloyed with the epoxy resins to provide adhesives of reduced cost for polyester laminates. There also seems to be room for the use of epoxies with vinyls to improve the heat resistance of the latter.

Potting and Casting

Epoxy resins very early in their development were used in the potting and encapsulating fields, and the requirements of this use have led to a great many attempts to modify the resins. The pure epoxy materials are quite rigid, and most potted assemblies require a degree of flexibility to provide for thermal expansion and contraction of the resin around the encapsulated components.

Epoxy-Polyesters and Alkyds—The first attempts were made with polyester resins, and a number have been marketed. An interesting formulation called for equal portions of a medium-molecular-weight epoxy resin, e.g., Araldite[4] CN-501, and Paraplex[5] G20. This system can be cured with acids or amines, but compatibility of the Paraplex resins with epoxies is better with the acid-cured systems.

It appears obvious that many other polyester-epoxy combinations can be made to suit the desires of the user. Undoubtedly, epoxy resins are being added to polyesters to improve adhesion. The fact that the acid anhydrides used to cure the epoxy resins also react with alcohols to produce alkyd resins would appear to provide unique opportunities to produce copolymers *in situ*, and this type of system may well increase in use as soon as its merits are recognized.

The physical properties of epoxy-polyester resins are not outstanding, but are adequate for many purposes. The working properties, such as pot life and viscosity, are, however, very satisfactory. A typical set of properties of polyester-epoxy resin is given in Table I.

Epoxy-Thiokol Rubbers—The attempt to provide low temperature flexibility in epoxy resins led to the use of Thiokol formulations that

[3]Tradename of Bakelite Co., a Division of Union Carbide and Carbon Corp.

[4]Tradename of Ciba Co., Inc.
[5]Tradename of Rohm & Haas Co.

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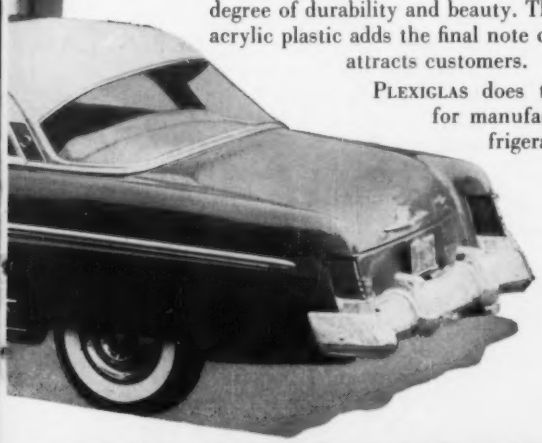

CHEMICALS FOR INDUSTRY

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have become very successful as cable-splicing, potting, and dipping compounds. Some of the working, physical, and chemical properties obtainable with Thiokol-modified epoxy resin are shown in Table II.

Thiokol-rubber alloys with epoxy resins can be used either with acid catalyzed or amine catalyzed systems, but the latter are more generally used. They are available as prepared formulations from Nureco, Inc., Cranston, R. I., and Houghton Laboratories, Olean, N.Y.

Epoxy-Polyamide—The polyamide resins produced by General Mills have proven to be excellent in epoxy potting alloys. They provide long pot life, low viscosity systems, and rapid cure. They are used instead of the Thiokol systems whenever possible because of the better working properties, but they lack the latter's low temperature flexibility. The rapidity of cure of these alloys indicates that they may be useful as starting points for epoxy molding resins. Typical data on the rapid curing and properties obtainable using General Mills' polyamide #100, are shown in Table III. Electrical properties of these resins are good, and these alloys will be very important when better known.

Epoxy-Phenolic—Casting alloys of this type are not in great demand. Epoxy resins are chiefly used in castings to provide low shrinkage and toughness. Phenolic resins can contribute little to a straight epoxy casting except a higher heat distortion and a lower price. The latter, however, is also obtainable with fillers, and so there is little incentive for epoxy-phenolic casting resins.

There is, on the other hand, a great interest in epoxy-phenolic molding compositions, since, theoretically at least, the epoxy resin would contribute toward dimensional stability of the molded part and adhesion to inserts. The amount of work that is being devoted to this application will very likely be successful in the next year or two and, no doubt, they will be followed still later by epoxy-melamines. At the present, however, there are no phenolic or melamine alloys with epoxies for potting or molding that are of commerical importance.

Epoxy-Oil—Epoxy-oil potting compounds have been produced for some time and, like the epoxy-rubber type, are used mainly for their resiliency. The long curing cycle and the poor properties at high temperature have not encouraged much work on this type of alloy, although one compound produced by Acme Wire Company has been very successful.

Epoxy-Asphalts—Although it has been known for some time that epoxy resins are compatible with asphalts when acid catalyzed, this type of alloy is not in use in significant quantities. It appears to be of promise as an asbestos felt impregnant, and a floor tile resin where chemical resistance, especially sol-

Table II—Properties of Thiokol-Modified Epoxy Resin

Thiokol/Araldite	*1/2*	*1/1*	*2/1*
	Ingredients, Parts		
Thiokol LP-33 (Thiokol Chemical Corp.)	100	100	200
Araldite CN-503 (Ciba Co., Inc.)	200	100	100
DMP-30 (Rohm and Haas Co.)	20	10	10
	Working Properties		
Viscosity[a] at 80° F., poises	52	34.5	25.5
Pot life[b] at 80° F., min.	9	12	80
Maximum exotherm[b], °F.	170	188	153
	Physical Properties[c] (Cured 24 hr. at 80° F.)		
Shore D hardness	43/49[d]	29/44[d]	18
Tensile strength, p.s.i.	925/4800[d]	450/2275[d]	350
Elongation, %	10/0-5[d]	160/30[d]	230
Impact strength,[e] ft.-lb.	50-70	72	72
	Resistance to Inorganic and Organic Liquids[f]		
Swelling volume after 30 days at 80° F., %			
Hydrochloric acid, 10%	2	6	—
Sulfuric acid, 20%	2	5	—
Ammonium hydroxide, conc.	11	33	—
Sodium hydroxide, 10%	2	2	—
Sodium hydroxide, 50%	—1	2	—
Sodium carbonate, satd. soln.	2	3	—
Aluminum sulfate, satd. soln.	1	2	—
Sodium chloride, satd. soln.	2	4	—
SR-6 (aromatic aviation gas)	0	2	6
Benzene	23	32	89
Methyl ethyl ketone	13	21	5
Carbon tetrachloride	0	18	40
Ethyl acetate	20	25	50

[a] The viscosity of Araldite CN-503 alone was 215 poises at 80° F.
[b] 300-g. batch in a 16-oz. cardboard container (2 1/4-in. diameter).
[c] Tests preformed on 1/16 in. thick cast sheets.
[d] Heated for 70 hr. at 212° F. The compound did not cure fully at 80° F.
[e] Free-falling ball method, MIL-C-16923 (Ships); the impact strength of cured Araldite CN-503 alone was less than 6 ft.-pounds.
[f] ASTM Procedure D 471-51T, Method B.

Table III—Properties of a 50-50 Mixture of Polyamide and Epoxy Resins

Epoxy resin	*Supplier*	*Reaction temp.*	*Time to gel*	*Properties of fully cured piece*
			min.	
Araldite CN-503	Ciba	170° C.	15-30	Soft; flexible
Araldite AN-101	Ciba	170° C.	15-30	Hard; flexible
Epon 1001	Shell	170° C.	5-10	Hard; flexible
Epon 834	Shell	170° C.	20-30	Soft; flexible

Table IV—Properties of Epoxy-Thiokol Glass-Cloth Laminates[a]

Laminate	*DMP-10*	*Araldite CN-502*	*Araldite CN-503*	*Thiokol LP-3*	*Ultimate flexural strength Dry*	*Modulus of elasticity Dry*	*Ultimate flexural strength Wet*	*Modulus of elasticity Wet*
					p.s.i.	*10^6 p.s.i.*	*p.s.i.*	*10^6 p.s.i.*
1	10	100			54,300	2.2	34,500	1.9
2	10		100		49,900	1.9	35,600	1.6
3	30		300	100	46,700	1.8	25,400	1.5
4	10		400	100	54,200	1.75	35,000	1.7
5	50		500	100	56,600	2.1	37,300	1.9
6	60		600	100	48,600	2.0	36,900	1.8
7	30	300		100	31,000	1.7	9.100	Too low
8	40	400		100	35,800	1.8	10,590	Too low
9	50	500		100	34,400	2.2	14,600	Too low
10	60	600		100	24,000	—	10,100	Too low

[a] The laminates were prepared with 181 glass cloth; 12 plies of glass cloth were used to make a 1/8 in. thick laminate. Cure cycle was 30 min. at 250° F. The glass content was approximately 75 percent.

Table V—Properties of Epoxy-Polyamide Glass-Cloth Laminates[a]

Formulations (parts by weight)	*3 CN-502 2 Polyamide 115*	*4 CN-503 3 Polyamide 115*	*1 CN-504 1 Polyamide 115*
Flexural strength, dry, p.s.i.	57,600	35,000	47,550
Flexural strength, wet, p.s.i.	27,150	38,400	17,570
Percent loss	58%	None	63%
Modulus of elasticity, dry, 10^6 p.s.i.	1.66	1.81	1.48
Modulus of elasticity, wet, 10^6 p.s.i.	1.62	1.81	1.43

[a] Laminates made with 6 plies of 181-114 glass cloth; the glass content was approximately 65%. Laminate thickness was ⅛ in.; cure cycle was 20 min. at 300° F.

vent resistance, is important. Perhaps the high cost of the epoxy resin has prevented this use from being exploited, but we feel that insufficient work has been done on this type of alloy.

Laminates

Epoxy resins, themselves, have only recently begun to be prominent in laminating, although their properties have been under investigation for this use for some time. It is to be expected, therefore, that epoxy laminating alloys should be somewhat fewer than in the other fields. The information on their uses is very meager at present, but it is increasing faster than any other branch of the epoxy field.

In a laminating alloy the epoxy resin is generally used to supply adhesion to the glass and high strength; the other resins are used to give increased moisture resistance or improved chemical and heat resistance.

Epoxy-Furan—The development of a furan resin that will cure in thick sections by Furane Plastics, Inc., was followed very rapidly by furan-epoxy alloys for laminating. Little data is available as to the properties such a laminate gives, but the high chemical resistance and temperature stability of the furan resin, coupled with the adhesiveness and toughness of the epoxy certainly are of theoretical interest.

Epoxy-Thiokol—As in potting, Thiokol compounds have given a degree of flexibility and impact resistance to epoxy resins that is quite valuable. High pressure bottles for oxygen and other gases are being manufactured from this alloy. The laminates have better vibration, fatigue, and, in some cases, better chemical resistance than epoxy resins alone. Typical properties of a laminate prepared with epoxy-Thiokol binder 114 are shown in Table IV.

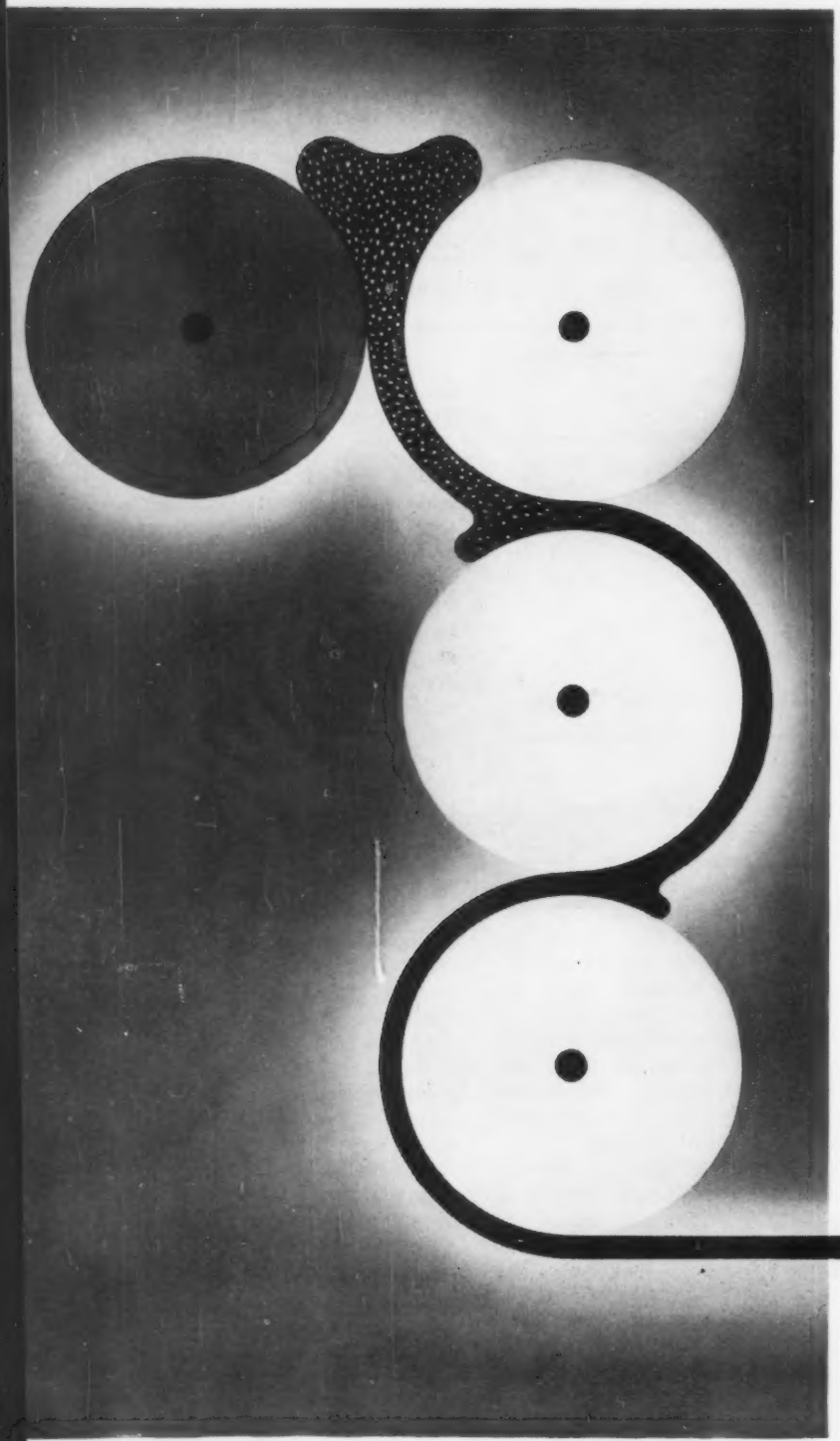
Epoxy-Polyamide—Epoxy-polyamide resins are suitable as laminating materials. They provide a degree of flexibility less than Thiokol but have, in distinction to the Thiokols, better pot life, odor, and other working properties, and, of course, greater simplicity, since the polyamide also acts as the curing agent. Polyamide resins, in addition, offer better electrical properties than the Thiokols. The mechanical properties of an epoxy-polyamide alloy in laminates are shown in Table V.

Epoxy-Polyester—It is surprising that more alloys of polyester-epoxy resin are not available at the present time. Some work has been done to produce pipe from a polyester-epoxy alloy, but the work was not entirely successful due to the difficulty in obtaining good curing in the time available. Epoxy resins could provide vibration resistance to polyester laminates, and the polyester can reduce the cost of the epoxy resin. The great difficulty at the present time seems to be the large difference in curing times of epoxy resins and the available polyesters. Undoubtedly the cure time of epoxy resins will be shortened soon, and we may then expect to see more polyester combinations.

Epoxy-Melamine — Epoxy-melamine laminates have not been reported, but undoubtedly are being

(*To page* 240)

and now...



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PLASTICS DIGEST*

Abstracts from the world's literature of interest to those who make or use plastics or plastics products. Send requests for periodicals to the publishers listed.

General

WHY MORE PLASTICS? A. Renfrew. SPE J. *10*, 22-23, 41-42 (Apr. 1954). Plastics at present in common use suffer from many disadvantages. Almost all plastics have the C-C skeleton. Few can be used at temperatures above 300° C. and not many can be exposed to the weather for more than a year or two without deterioration. Prices are high but can be expected to decrease as volume continues to increase. However, the new plastics that will be developed in the future will not differ in any spectacular way from the old ones. Changes in the industry will consist of such things as trends toward quality, uniformity, and standardization, and an increased understanding of the structure of plastics. Such new techniques as grafting and irradiation will widen the scope of thermoplastics. There will also be new applications for plastics and improved fabricating techniques.

Materials

SARAN-COATED CELLOPHANE. Modern Packaging *27*, 80-83 (Apr. 1954). The properties and applications of saran-coated cellophane are described. Saran-coated cellophane combines some of the best properties of saran film with the most desirable qualities of cellophane, and in doing so, overcomes some of the limitations of each material. Saran film has long been known for having the lowest rate of water-vapor transmission of any transparent film commercially used in packaging, as well as for its strength, dimensional stability, and resistance to acids, alkalies, gases, and the effects of aging. These are points on which ordinary, uncoated cellophane is weak. But as a film saran has been restricted in application because of the relatively high cost, special heat-sealing requirements, and above all—a weakness which it shares with all other straight plastic films to date—inability to handle readily in high-speed automatic packaging machinery. When applied as a thin coating to cellophane, saran loses some of its water-vapor resistance. But it retains most of its other properties almost unimpaired, and because of the relatively small quantity spread as a coating, its cost comes down to practical level. Because of the thinness of the coating, heat sealing poses no difficulty and, with the "body" provided by the cellophane, machine-handling properties of the coated material are as excellent as those of cellophane itself. When properly coated with a cellulose nitrate lacquer, as it has been for many years in the popular "MS" types, cellophane is itself, of course, a good water-vapor barrier. When saran is substituted for the cellulose nitrate coating, the water-vapor transmission rating is at least as low, and the other advantages mentioned above are gained.

POLYETHYLENE-COATED CELLOPHANE. L. C. Swec and G. H. Sullivan. Modern Packaging *27*, 203-08, 294, 296, 299, 300, 304 (Mar. 1954). The properties of polyethylene-coated cellophane are described. Properties discussed include various strength characteristics, folding endurance, water vapor transmission, and gas permeability. Methods of sealing and applications are also considered.

TYPES OF RESINS FOR GLASS-REINFORCED POLYESTER LAMINATES. E. M. Evans. Brit. Plastics *27*, 100-103 (Mar. 1954). The composition of commercial polyester resins and the effects of the basic components such as glycols, unsaturated acids, modifying acids, monomers, catalysts, stabilizers, and accelerators on the properties of the polymer are discussed. Typical handling procedures are presented. Weaknesses of polyester resins are 1) the ester grouping where the most stringent water resistance is required, 2) the styrene cross-linkages where heat stability is concerned, and 3) styrene where fire resistance is important. Practical examples are given of the application of the principles of tailoring resins for specific purposes by discussing the type of polyester resins required for boats and for piping.

BLENDS OF PHENOLIC RESINS WITH RUBBER. R. C. Bascom. India Rubber World. *129*, 30-31 (Feb. 1954) Phenolic resins and most rubbers are inherently not compatible. However, nitrile rubbers are compatible with these resins. The most useful cured blends of phenolic resins and nitrile rubbers are made with highly modified resins and nitrile rubbers with acrylonitrile content of the order of 40 percent. The rubber increases elongation and impact strength of the phenolic resins while it lowers hardness and tensile strength. The preparation and processing of these blends are discussed. Applications include shoe-sole reinforcement and adhesives.

SOME SULFONAMIDE PLASTICIZERS AND WAXES. D. Aelony. Ind. Eng. Chem. *46*, 587-91 (Mar. 1954). Several series of aromatic sulfonamide derivatives were synthesized and tested for plasticizing action on Vinylite VYNW and for wax-like properties. Emphasis was on the relationship between chemical structure and compatibility, elongation, and minimum flex temperature. While one sulfonamide grouping per molecule enhances the plasticizing properties, two sulfonamide groups per molecule are hardly advantageous. The same applies to a lesser degree to ester groups, but only to compounds of a certain molecular weight. If this range is greatly exceeded, the above statements may no longer be true. A number of the sulfonamides, particularly the N-β-hydroxyethyl and the N,N-di-β-hydroxyethyl derivatives, had wax-like properties that made them suitable for polishes.

Molding and Fabricating

ADIABATIC EXTRUSION OF POLYETHYLENE. J. M. McKelvey and E. C. Bernhardt. SPE J. *10*, 22-30, 42-43 (Mar. 1954). Data are presented from polyethylene extrusion experiments in which the extruder was operated under near-adiabatic conditions;

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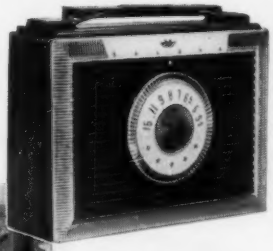
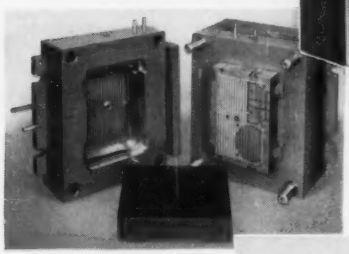
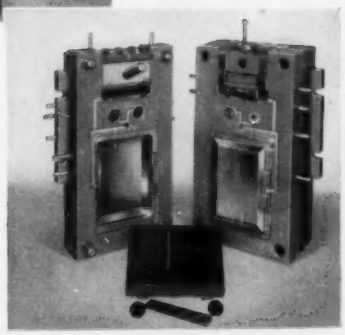


Bulova "Companion" 3 Way Portable Radio



Bulova front-of-cabinet die



Bulova back-of-cabinet, handle, and knob die

BULOVA WATCH COMPANY, INC.

ELECTRONICS DIVISION

VALLEY STREAM, LONG ISLAND, N. Y.

March 5, 1954

Mr. Philip Graham
President
Worcester Moulded Plastics Company
14 Hygeia Street
Worcester 8, Massachusetts

Dear Mr. Graham:

Please convey the sincere thanks of the Bulova Watch Company to your entire organization for a job well done. This is the first experience in my 15 years in the radio business where a moulder has turned out a quality job on the date promised. I hope this inaugurates a prosperous relationship between our companies.

Cordially,

BULOVA WATCH COMPANY, INC.

Hank Randall

H. M. Randall
General Manager
Electronics Division

HMR:jl

Custom Injection Mouldings of Custom-Made Quality

WORCESTER MOULDED PLASTICS CO.

14 HYGEIA STREET, WORCESTER 8, MASS.

these data are analyzed in terms of the adiabatic melt flow theory and conclusions are drawn as to the usefulness of the adiabatic theory in practical extrusion problems. The results show that polyethylene extrusion under near-adiabatic conditions is obtainable in practice. While the correlation between the observed and calculated performance is not perfect, the adiabatic melt extrusion theory can serve as a semi-quantitative guide to the design of extruders for operation with predominantly mechanical power. The experimental work also shows that any combination of a very wide range of extrusion rates and temperatures can be obtained without any transfer of external heat to the plastic and that the ultimate capacity of the extruder for polyethylene is limited only by the speed and power that the drive can supply. Further experimentation would be necessary to determine if other plastics can also be extruded under near-adiabatic conditions.

PRESSURE EFFECTS DURING THE INJECTION MOLDING OF POLYSTYRENE. S. D. Eagleton. Brit. Plastics *27*, 95-99 (Mar. 1954). The effect of lubricants on the pressure loss in the solid zone of an injection molding machine and the effects of pressure on the temperature of the polymer are discussed. Within certain limits, the addition of small amounts of lubricant greatly increases the pressure transmitted to the mold. The temperature of the polymer in the nozzle of the injection machine rises as the pressure is applied by the plunger. The loss of pressure caused by pin-point gating is discussed and a specially-designed mixing device is illustrated which may be regarded as a pin-point gate with zero length of land. Increases in internal strains of moldings as the pressure is increased are discussed.

A METAL-DETECTING INSTRUMENT FOR THE PLASTICS INDUSTRY. H. Kalpers. Kunststoff-Rundschau *1*, 58-59 (Mar. 1954). An electronic metal-detecting instrument was developed that will work either completely automatic or can give acoustical or optical signals so that the metal pieces may be removed by the operators.

CUTTING CIRCULAR SECTIONS FROM MOLDED LAMINATES WITH CIRCULAR SAWS. K. Maylahn. Kunststoffe *44*,

122, 124 (Mar. 1954). Practical experience has shown that the use of circular saws for cutting circular sections from molded laminates up to a thickness of 0.59 in. (15 mm.) is superior to other methods. Above 1.18 in. (30 mm.) the application of band saws is recommended. For materials of thicknesses between 15 and 30 mm., experiment should determine for each case which kind of saw is best.

Applications

FOUR MOLDINGS FOR TV CABINET. Brit. Plastics *27*, 78-81 (Mar. 1954). A television cabinet produced in four separate parts from wood-flour-filled phenolic powder is described. The advantages of producing this piece in four parts rather than the conventional one piece are discussed, as well as the problems encountered in design and production. The four-piece cabinet decreased storage space, advanced tool delivery date, reduced transportation costs, and resulted in less molding powder waste.

POLYTHENE PIPE FITTINGS. Brit. Plastics *27*, 94 (Mar. 1954). A number of new polyethylene pipe fittings are shown. These fittings are injection molded of polyethylene with 20% carbon black and 0.2% antioxidant. The fittings include tees, elbows, junctions, and couplings.

Coatings

MICROSTRUCTURE OF PAINT FILMS. E. G. Bobalek, L. R. LeBras, A. S. Powell, and W. von Fischer. Ind. Eng. Chem. *46*, 572-77 (Mar. 1954). Improved methods were applied to the study of the air interface of enamel and lacquer films and to the adhesion interface of these films stripped electrolytically from tin plate. Replica techniques proved useful in studying the surface structure of the resinous binder and observing surface structure variations caused by differences of pigment distribution in the film interfaces. The luster and color of paint films are affected by both binder structure and the flocculation and sedimentation properties of the pigment in the film. There seems to be some correlation between microstructure of films and sedimentation properties of liquid paints. The surface roughness of films is least for films formed from paints that tend to settle rapidly to a dense pigment

(*To page* 172)

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2, 3 and 500 Oz.

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2943

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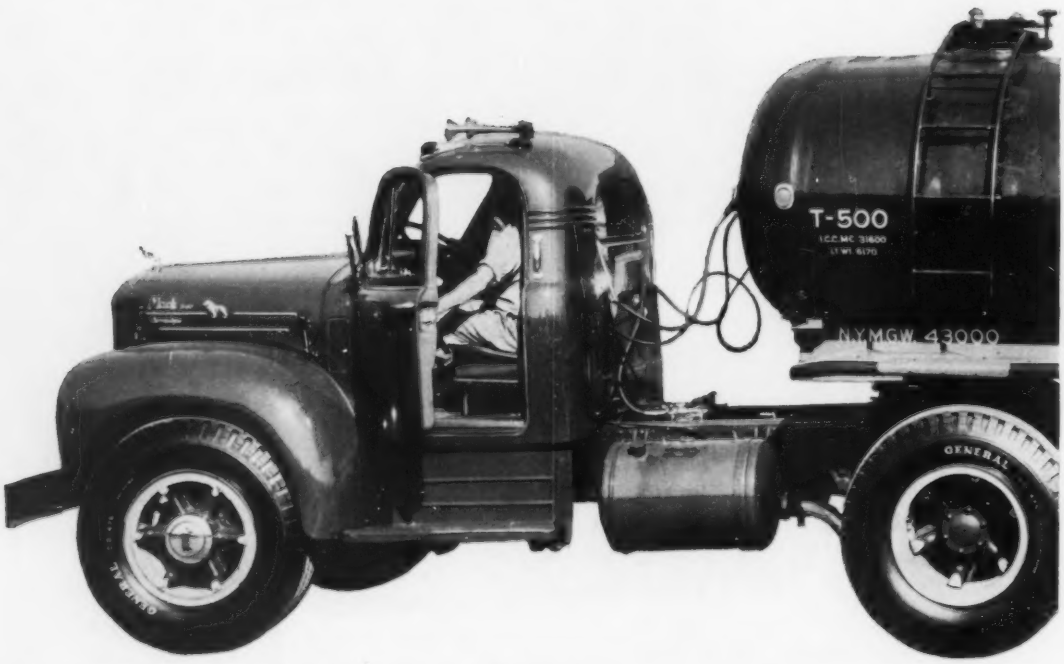

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Built to transport corrosive chemicals like formaldehyde, the tank is molded of Cyanamid's LAMINAC polyester resin, reinforced with fibrous glass mat. Its weight—only 7,025 pounds fully equipped and mounted . . . 3,600 pounds less than the tank it replaced. During the past year, this weight saving has increased payload within the over-the-road limit by more than $3,000! And LAMINAC's high corrosion resistance enabled Mutrie to dispense with the costly special lining required in ordinary tanks.

Perhaps this success story suggests an application where *you* might use large molded forms of LAMINAC to advantage. If so, we'll be glad to work with you.

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BEETLE® urea-formaldehyde molding materials . . .

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$3,000 YEARLY
of reinforced Laminac®

One of the largest one-piece molded structures ever made, this reinforced LAMINAC trailer tank is 21' 9" long, 6' 2" wide and 4' 4" high. Reinforced plastic structures, including tank, hose tubes tenders and pump cabinet molded by Carl N. Beetle Plastics Corp., Fall River, Mass. The tank is mounted on a Fruehauf trailer.

AMERICAN Cyanamid COMPANY
PLASTICS AND RESINS DIVISION
32 Rockefeller Plaza, New York 20, N. Y.

In Canada: North American Cyanamid Limited, Toronto & Montreal

packing. This sedimentation behavior of pigments in films or liquid paints is influenced greatly by vehicle-pigment interactions and cannot be predicted solely from data regarding particle size or extent of flocculation of the pigments. The usefulness of the electron microscope in the study of paint films of ordinary thickness has been extended greatly by the improvement of the silver-silica and polyvinyl alcohol-silica replica techniques.

Properties

FRICTIONAL PROPERTIES OF POROUS METAL IMPREGNATED WITH PLASTIC. F. P. Bowden. SPE J. *10*, 38, 40 (Mar. 1954). It was found that a film of Teflon when simply rubbed onto surfaces gave a low value of the friction, but the film was worn away. Porous metal was therefore impregnated with the plastic. Sintered copper impregnated in this way gave remarkably low values of friction. The friction begins to rise at temperatures where decomposition of the plastic would occur.

THEORY OF THE CHANGES IN PHYSICAL CHARACTERISTICS OF PLASTICS CAUSED BY RADIATION. J. W. Ryan. SPE J. *10*, 11, 40-41 (Apr. 1954). In discussing changes in plastics caused by nuclear radiation, the existence of a "functionality series" such that the highest functional group tends to transmit energy received from the interaction with a photon to a lesser transmitting group where it selectively decomposes is proposed. The term "functionality" means any one of the building units of the polymer in question. Evidence is presented for the existence of this series. This includes an explanation of the decomposition of Teflon upon exposure to radiation. Linear polyesters represent a potentially interesting set of materials because of the predominance of ester carboxyl groups and the relatively short distances between them.

CRAZING OF POLYSTYRENE. E. E. Zeigler. SPE J. *10*, 12-13, 16-21, 42-43, 46 (Apr. 1954). Development of a new simplified test method has made it possible to study the effect of a great many variables on the "critical elongation" for crazing of polystyrene. The test consists of clamping a strip of polystyrene over a bending form so designed as to provide constantly changing radius

of curvature and corresponding stress as well as strain in the test specimen. It is possible to observe the location of the last significant craze mark from which the percent elongation could be calculated. The manner in which crazing is affected by time, temperature, reagents, and exposure conditions was studied.

Chemistry

KINETICS OF ACRYLONITRILE POLYMERIZATION IN BULK. W. M. Thomas and J. J. Pellon. J. Polymer Sci. *13*, 329-53 (Apr. 1954). As a step toward the better understanding of acrylonitrile polymerization, a kinetic study was made in bulk with azo and peroxy catalysts over the range 30 to 60° C. Rates were followed gravimetrically in most cases, and molecular weights were estimated from viscosity measurements. Electron micrographs and nitrogen sorption data were obtained. Following a short induction period, polymer separated as a fine suspension, coagulated to form curds at a few tenths percent polymerization, and formed a hard, porous mass at about 60% reaction. The product at 5 to 50% polymerization was in the form of dense particles about 0.5 micron across; these appeared to be aggregates of 400 A. particles. The rate of polymerization accelerated up to 1 to 3% conversion and was then nearly constant to about 50%, beyond which it could not be measured. Rate increased with the 0.8 power of catalyst concentration and showed an over-all activation of 35 to 37 kcal./mole. Molecular weight varied inversely with the 0.2 power of the catalyst concentration, was nearly constant from 5 to 50% conversion, and went through a slight maximum with temperature. To account for these observations a kinetic scheme is proposed that involves the possibility of unimolecular chain termination by a process of "burial." This process is conceived of as a mechanism by which a growing chain may become shielded from further growth by coiling or embedding itself in the solid phase. Equations derived for rate and degree of polymerization fit the data adequately. Consideration is given to the simultaneous effects at high conversion of a small loss in initiator by thermal decomposition, of enrichment of the solution by shrinking liquid volume, and of monomer loss.

U. S. PLASTICS PATENTS

Copies of these patents are available from the U. S. Patent Office, Washington, D. C., at 25¢ each.

COATING. A. L. Glass (to U. S.). U.S. 2,676,942, Apr. 27. Corrosion-resistant coating.

FILM. C. M. Carson (to Goodyear). U.S. 2,676,943, Apr. 27. Red-meat packaging film of vinyl chloride polymer.

POLYMERS. N. A. Higgins (to Du Pont). U.S. 2,676,945, Apr. 27. Condensation polymers of hydroxyacetic acid.

MOLDING COMPOSITION. J. L. McCurdy and L. Kin (to Dow). U.S. 2,676,946, Apr. 27. Aromatic olefin compositions.

CATALYST. R. D. Rowley (to Westinghouse). U.S. 2,676,948, Apr. 27. Guanidine carbonate curing catalyst for polysiloxane resins.

COPOLYMERS. R. R. Morner and R. I. Longley, Jr. (to Monsanto). U.S. 2,676,949, Apr. 27. Copolymers of maleic anhydride and N-vinyl lactams.

TRIPOLYMERS. W. J. Sparks and D. W. Young (to Standard Oil). U.S. 2,676,950, Apr. 27. Curable polymers from a diolefin, an alkene, and styrene.

POLYMERS. G. E. Ham (to Chemstrand). U.S. 2,676,953, Apr. 27. Aromatic-aliphatic cyano derivative polymerization catalysts.

METHYL METHACRYLATE. G. Kirkegaard (to L. C. Krazinski). U.S. 2,676,954, Apr. 27. Methyl methacrylate modified to increase abrasion resistance.

TESTING MACHINE. R. B. Faris, Jr., H. F. Hardman, H. M. Stine, and M. Fink (to Standard Oil). U.S. 2,677,271, May 4. Apparatus for testing plastics materials.

TESTING MACHINE. S. S. Dabrowski. U.S. 2,677,275, May 4. Machine for testing adhesiveness of paint films.

COATING. F. L. Schouteden (to Gevaert Photo-Producten). U.S. 2,677,622, May 4. Coating fabric with vinyl resins.

BONDING. S. E. Urban, T. C. Morris, and E. C. Johnson (to B. B. Chemical). U.S. 2,677,635, May 4. Bonding sheet plastic to a porous surface such as concrete.

WATERPROOF PRODUCTS. A. F. Bidaud (to Societe des Usines Chimiques Rhone-Poulenc). U.S. 2,677,658, May 4. Composition of silicone resin and silicon dioxide.

RESINS. R. Kunin and S. Rothman (to Rohm and Haas). U.S. 2,677,670, May 4. Choline carboxylate cation-exchange resins.

INTERPOLYMERS. H. Yuska, A. M. Tringali, and J. E. Hanle (to Interchemical). U.S. 2,677,671, May 4. Interpolymers of methacrylic esters, epoxy resin esters, and Diels-Alder adducts.

ADHESIVE. S. B. Luce (to Swift). U.S. 2,677,672, May 4. Wood adhesive consisting of polyvinyl acetate emulsion and a vinyl-methyl-ether maleic-anhydride copolymer.

COPOLYMERS. C. S. Marvel and R. M. Joyce (to Du Pont). U.S. 2,677,673, May 4. Copolymers of methacrylonitrile dimers.

POLYMER BLENDS. L. E. Daly (to U.S. Rubber). U.S. 2,677,674, May 4. Blends of styrene-divinylbenzene and styrene-butadiene.

PHENOLIC RESINS. D. E. Nagy (to American Cyanamid). U.S. 2,677,675, May 4. Sulfonated phenolic resins.

POLYMERS. G. M. Nichols and C. J. Albisetti (to Du Pont). U.S. 2,677,676, May 4. Polymers from adipic acid derivatives.

POLYMERS. J. W. Fisher and E. W. Wheatley (to British Celanese). U.S. 2,677,677, May 4. Polyamino-triazoles.

POLYMERS. R. C. Morris and V. W. Buls (to Shell). U.S. 2,677,678, May 4. Copolymers of unsaturated benzoates.

POLYMERS. A. L. Barney (to Du Pont). U.S. 2,677,679, May 4. Quaternary ammonium polymers of the acrylic type.

PLASTIC SHAPING. R. C. Jaye. U.S. 2,677,747, May 4. Apparatus for shaping cellular plastics.

ADHESIVE. F. W. Holt, Jr. (to Brown Bridge Mills). U.S. 2,678,284, May 11. Thermoplastic adhesive which is non-tacky at room temperature.

COATING. J. Browning (to Imperial Chemical). U.S. 2,678,285, May 11. Antistatic coatings for thermoplastics.

SHRINKPROOFING. M. E. Cupery and S. R. Detrick (to Du Pont). U.S. 2,678,287, May 11. Shrinkproofing wool with substituted polyethylenes.

CELLULAR RESINS. E. B. McMillan and A. R. Olson (to United Shoe Machinery). U.S. 2,678,293, May 11. Cellular butadiene-styrene.

ION EXCHANGE. A. F. Ferris (to Rohm and Haas). U.S. 2,678,306, May 11. Carboxysulfonic cation-exchange resins.

RESINS. T. J. Suen (to American Cyanamid). U.S. 2,678,308, May 11. Alkyl-modified aminoplasts.

CELLULOSE ESTERS. N. Van Gorder and W. D. Paist (to Celanese). U.S. 2,678,309, May 11. Haloalkyl phosphate—lower aliphatic acid mixed esters of cellulose.

TOOTH. F. A. Slack, Jr. (to H. D. Justi and Son). U.S. 2,678,470, May 18. Method of molding artificial teeth.

CELLULOSE DERIVATIVES. H. Schnell and H. Rinke (to Farbenfabriken Bayer). U.S. 2,678,869, May 18. Isocyanate-modified cellulose derivatives.

LEATHER TREATMENT. T. A. Kauppi (to Dow Corning). U.S. 2,678,893, May 18. Waterproofing leather with a methyl polysiloxane.

PRINTING PASTE. W. Graulich, W. Becker, and O. Bayer (to Farbenfabriken Bayer). U.S. 2,678,924, May 18. Textile printing with acrylic copolymers.

COPOLYMERS. H. J. Hagemeyer, Jr. and R. E. DeBusk (to Eastman

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Kodak). U.S. 2,678,925, May 18. Pressure-polymerized copolymers of acrylonitrile and unsaturated esters.

BATTERY SEPARATOR. E. C. Uhlig and A. DeFusco (to U. S. Rubber). U.S. 2,678,961, May 18. Paper impregnated with "Vinsol" and phenolic resin.

POLYETHYLENE. J. G. Bedford (to Ciba). U.S. 2,679,469, May 25. Welding polyethylene.

MOLDS. C. K. Swartz (to Consolidated Molded Products). U.S. 2,679,473, May 25. Preparing molds to produce crackle finishes.

PLASTICS. K. D. Meiser and A. W. Kassay (to Allied Chemical). U.S. 2,679,490, May 25. Urea-formaldehyde cellulosic molding powders.

ACRYLONITRILE. N. A. Hampson, J. Downing, and J. G. N. Drewitt (to British Celanese). U.S. 2,679,492, May 25. Solutions of polyacrylonitrile.

ALKYD RESINS. T. F. Anderson (to Allied Chemical). U.S. 2,679,493, May 25. Stabilized thermosetting alkyd compositions.

ACRYLONITRILE. W. M. Thomas (to American Cyanamid). U.S. 2,679,494, May 25. Modified acrylonitrile polymers.

WATERPROOFING. R. H. Bunnell (to Allied Chemical). U.S. 2,679,495-6, May 25. Siloxane waterproofing compositions.

POLYMERIZATION. C. A. Uranek and S. H. Landes (to Phillips Petroleum). U.S. 2,679,497, May 25. Use of rosin soaps in emulsion polymerization.

CONDENSATES. R. P. Seven and J. J. Miyashiro (to Ringwood Chemical). U.S. 2,679,498, May 25. Diazo condensation polymers.

FILMS. W. J. Bennes and C. E. Leyes (to Celanese). U.S. 2,679,661, June 1. Film formation by extrusion.

DISPENSER. N. T. Baldanza (to Curtiss-Wright). U.S. 2,679,875, June 1. Plastic dispenser.

POLYETHYLENE. J. F. Doyle and P. L. Onasch (to Arkell Safety Bag). U.S. 2,679,887, June 1. Crinkled laminated polyethylene.

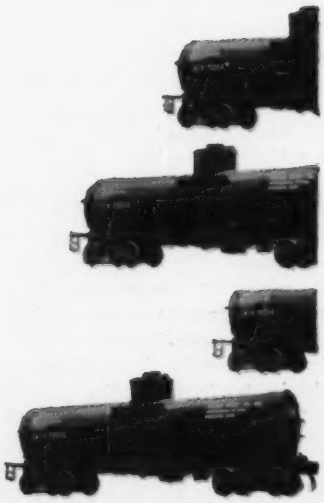
EMULSION. L. Schibler and A. Laely (to Ciba). U.S. 2,680,101, June 1. Emulsions of aminoplasts.

A product of progress

THROUGH INTEGRATION

FOSTARENE®

A VIRGIN POLYSTYRENE



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A PIONEER IN PLASTICS FOR OVER THIRTY YEARS

NEW MACHINERY AND EQUIPMENT

Spray Decorating—An all-electric, automatic spray-decorating machine with an integral mask washer operates with a traversing spray gun. It is claimed that the machine saves time by eliminating the necessity for stopping the machine to remove soiled masks and replace with clean masks. Washing of one set of masks takes place during the painting operation and without mask removal. The operator merely throws a switch and clean masks are shuttled into position for painting. In addition to the saving in time, this arrangement precludes the possibility of an operator keeping a mask in service so long that the machine will no longer operate at top efficiency. A single-operator unit requires four masks; two in the painting area and two in the washer. The mask washing operation continues even though the painting operation may be momentarily suspended. The wash cycle is controlled up to 2 minutes. The wash pattern is flexible and adjustable to insure adequate cleaning of both top and bottom sides. Mask washing is accomplished by a high-pressure system with a series of non-clogging nozzles set on ½-in. centers. After the mask is washed, and before it is returned to the painting position, a jet of clean air removes all moisture so that no work can be spoiled by wet masks. Washing solvent capacity is 65 gal.; the washer is powered by a 3-hp., 54-gal./min. pump at 30 p.s.i. A visible fluid level gage indicates when solvent must be added. A ¾-h.p. motor drives a 24-in. diameter fan which provides air at the rate of 5800 cu. ft./min. for the mask drying operation.

Production runs of 2400 pieces per hour are reported for single-operator machines. When guns are stationary, the machine can be made to cycle up to 3600 per hour, if the operator can load it that fast. *Conforming Matrix Corp., 364-1 Factories Bldg., Toledo 2, Ohio.*

Inspection Tool—Pocket Comparator for the measurement of extremely small parts or minute dimensions on large parts, consists of a magnifying lens (six power) in an acrylic housing, and tiny transparent patterns called reticles. These reticles are extreme reductions of "master" layouts of scales for the measurement of radii, threads per in., diameters, angles, thicknesses, fractional dimensions, and linear scales. A separate reticle is available for each of these. The instrument comes equipped with a "Scales" reticle, to measure dimensions from 0.0025 to 0.5 in., and 0 to 0.10 millimeters.

In operation, the comparator is placed over the area to be measured, with the appropriate reticle in place. Viewing through the lens, the desired dimension information can be read on the reticle scale. Focusing is accomplished by sliding the eye piece in or out of the acrylic body. Fine adjustment is obtained through a built-in screw arrangement.

The instrument finds application in the tool room (checking forms and sizes of punches and dies, and templets) and on the production line. *National Tool Co., 11200 Madison Ave., Cleveland 2, Ohio*

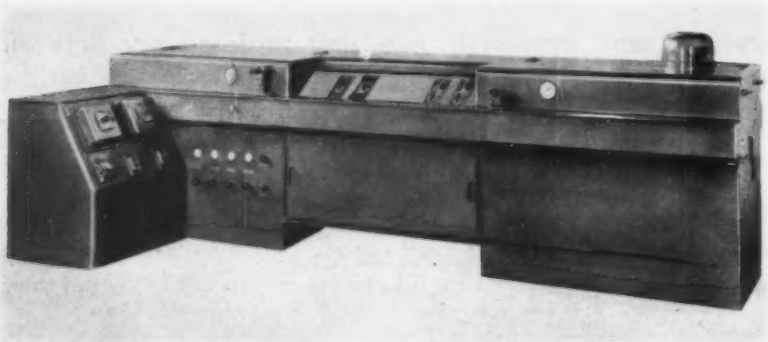
Marking Machine—Model 99-A marking machine is a power-driven unit which is reported to make practical the marking of large assembled parts with flat or simple-curvature surfaces. The unit, operating from a gear reduction motor, can mark parts 9 in. or less in thickness.

Marking is automatic, with a lever at one side of the gear reduction box permitting the operator to stop and start the unit at will. Feeding and removal of work is manual; however, automatic feeders and ejectors can be attached when so desired. All operating parts, except for the marking die, are completely enclosed for safety. Adjustment on the machine is sufficient to take variations up to 2 inches. Length of stroke is 8 inches. Speed of operation is adjustable.

Over-all size of Model 99-A is 24 in. high, 18 in. deep, and 36 in. long. *The Acromark Co., 310 Morrell St., Elizabeth, N. J.*

Vacuum Forming Unit—Drape and vacuum forming machine Formvac G has infra-red heater operating at a maximum temperature of about 1400° F. The heater is divided into four zones; if a smaller than over-all heating area is desired, elements outside the required area may be switched off. Before the heater is driven off the sheet into rest position, its temperature—within about 2 sec. —automatically drops to below ⅔ of its operating temperature. Full operating temperature is regained in about the same time once the heater is back over the sheet. Movement of the heater is automatic.

These features are claimed to result in savings of current of between 30 and 70 percent. On a heater which covers, for instance, a 24- by 60-in. maximum molding area, current consumption would be as follows:



Conforming Matrix's automatic spray decorating machine has integral mask washer

MODEL
H-250

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VAN DORN
2½ Oz. Automatic Press

Check these outstanding features of this ultra-modern Van Dorn injection press:—

GREATER CAPACITY— Up to 2½ oz.; smaller pieces at faster cycles.

HI-SPEED PERFORMANCE— Plasticizes material at 22 lbs. plus per hour.

FASTER PRODUCTION—Will attain up to 720 cycles per hour (dry run).

HIGHEST EFFICIENCY—Due to water cooling of injection plunger, transfer hopper and oil cooler.

ACCESSIBILITY— Due to simple platen clamp device for purging to change material or color.

MORE SAFETY— Mold hydraulic mechanism makes press non-operative unless molded part is completely ejected.

SIMPLER OPERATION—Due to automatic, adjustable material metering device.

MULTIPLE OPERATIONS—Minimum operator attention by use of larger hopper and light that indicates when press needs attention.

SELECTIVE CONTROL—Merely throw toggle switch to operate press semi-automatically.

DEPENDABILITY— Because of all-steel construction and Van Dorn's established reputation in the plastics machinery field.

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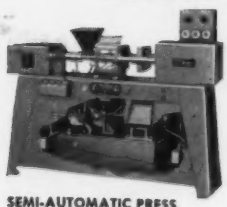
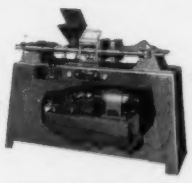
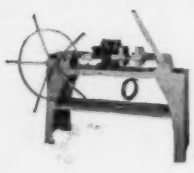
WRITE FOR COMPLETE DATA ON MODEL H-250 AND OTHER EQUIPMENT SHOWN



SEMI-AUTOMATIC PRESS
2-oz. capacity.

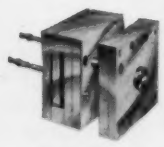


POWER OPERATED, LEVER CONTROLLED PRESSES
2-oz. and 1-oz. models

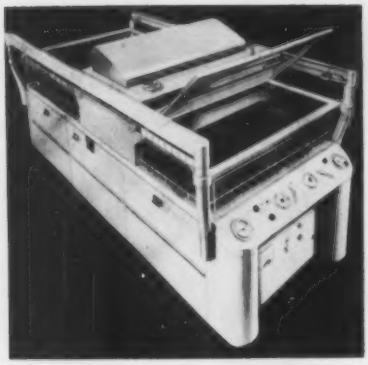


MANUALLY OPERATED PRESS
1-oz. For small jobs, training, etc.

PLASTIC GRINDER
Grinds up rejects, waste, etc., for re-use.



MOLD BASES
Available from stock.



Hydro-Chemie's Formvac G has infra-red heater whose elements, depending on molding area, can be selectively shut off

7 kw. for a 24- by 24-in. zone, 11 kw. for a 24- by 36-in. zone, 14.5 kw. for a 24- by 48-in. zone, and 18 kw. for the full molding area.

The machine's draping component operates by compressed air. The mold is pushed upward into the sheet which is held in a frame.

A device for presetting and maintaining temperature of water-cooled metal molds is said to make possible presetting the complete cycle of an entire production run.

These machines are self-contained production units, available in single or twin-table models, ready for connection to power source. They require compressed air at 100 p.s.i. minimum and water to cool metal molds. Two standard models are available: 24- by 60-in. molding area and 40- by 60-in. molding area. Depth of drape or draw is 14 in. maximum. Standard wiring is for 220, 380, 420, and 500 v., 3-phase, 50 or 60 cycles. *Hydro-Chemie, Ltd., 21 Dreikönigstrasse, Zurich, Switzerland.*

Environmental Tester—Simulation of a wide range of atmospheric and stratospheric conditions (humidities from 20 to 95%, altitudes up to 500,000 ft., temperatures from -150 to 400° F.) is made possible with a line of Brown Instrument-equipped test chambers. They find application in JAN and MIL specification tests, plasma storage, product evaluation, pharmaceutical production, and research activities. Instrumentation on the cabinets includes recording, controlling, and programming.

The Strato-Chamber test cabinet combines controlled vacuum, humidity, and temperature-producing devices so that very high altitude conditions, (up to 100,000 ft.) can be obtained and held. The Humidity-Temperature cabinet (series HT) provides controlled humidity and temperature conditions, but has no provision for controlled vacuum. *Hudson Bay Div., Refrigeration Systems, Inc., 646 W. Washington, Chicago, Ill.*

Injection Machine—Reported to cycle up to 400 times an hour, a fully automatic 6/8-oz. injection molding machine has been developed for the production of thin walled containers, toys, lighting fixtures, small electronic parts, etc.

The unit has a straight-line full-hydraulic clamp, with fast closing and opening speeds and automatic slow-downs prior to mold contact, at mold break-away, and during ejection of molded part.

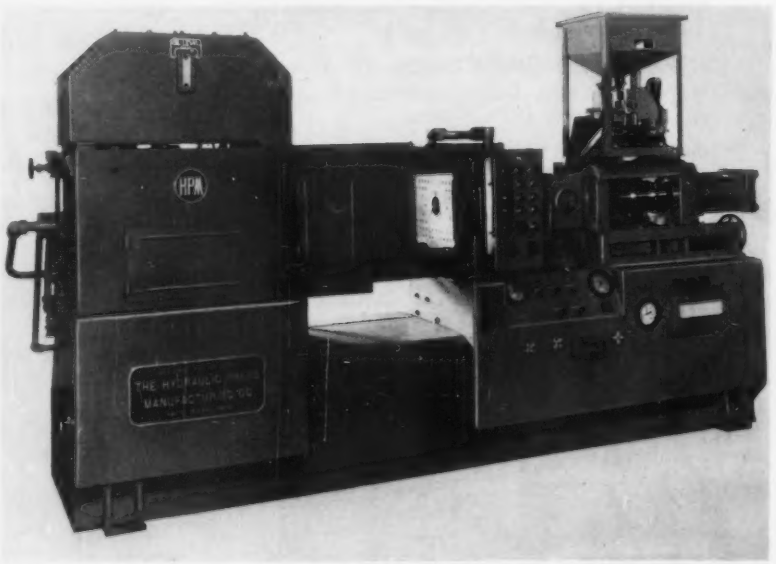
The ejection unit is mounted on ways and is actuated by a single hydraulic cylinder. A positive sprue break, hydraulically actuated, can be used at the option of the operator. The plasticizing chamber is equipped with three heat zones, each pyrometer-controlled. Heating bands are mounted directly on the spreader. A readily changed ram spacer permits use of thin molds without use of bolsters.

The oil tank is overhead-mounted. Valves are mounted on a sub-plate manifold. A front limit-switch panel, directly below the oil tank, permits all stroke adjustments to be made at the front of the machine.

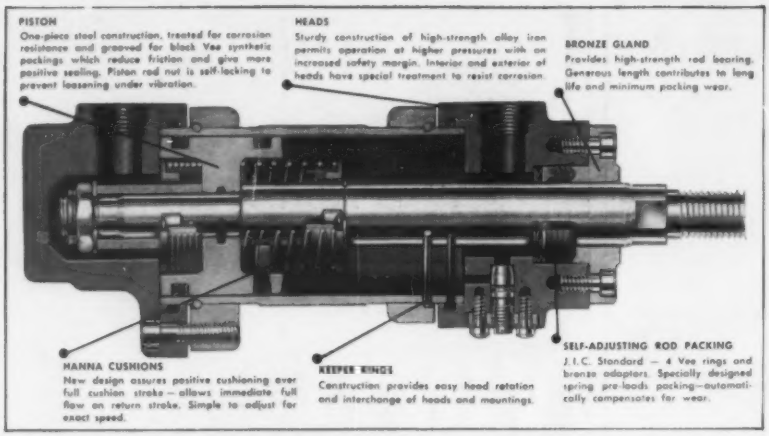
The manufacturer claims that one attendant can operate from four to six of the units. *The Hydraulic Press Mfg. Co., Mount Gilead, Ohio.*

Inspection Accessory—For use in determining whether work pieces meet close tolerance specifications, a snap gage with a large, flat-surfaced backstop is said to permit instant positioning of work pieces to get an accurate reading. An Allen-type set screw locks the backstop stud firmly in position, flush with the frame, for handling in close quarters. An adjustable indicator dial has a positive internal lock for fine settings and may be fitted with tolerance hands or plate, as required for specific operations. The indicator itself has no complex gears, but only a simple lever movement and special low-friction bearings.

Four models of the gage are available: SG 351 has an indicator (135F) graduated in 0.0005-in. increments and with a 0.125-in. range; capacity of the gage (vertical) is 0 to 1⅛ in., plus the range of the indicator; maximum throat capacity is 1 inch. Model SG 451 has an indicator (145F) graduated in 0.0001-in. increments with a 0.060-in. range; same capacity as SG 351. Model SG 352 has the 135F indicator, capacity



Hydraulic Press' 6/8-oz. injection machine has straight-line, full hydraulic clamp



Hanna Engineering's hydraulic cylinder, series 720, has capacities up to 750 p.s.i.

of ¾ to 2⅛ in., plus range of indicator, and maximum throat capacity of 2 inches. Model SG 452 uses indicator 145F and has same capacity as Model SG 352. *Chicago Dial Indicator Co., 180 N. Wacker Dr., Chicago, Ill.*

Filter—Designed to prevent dirt, oil, water, and other foreign matter from entering pneumatic instruments, an air filter, measuring approximately 8½ in. high and 4⅛ in. in diameter, can be mounted in a supported line or bolted to wall or panel.

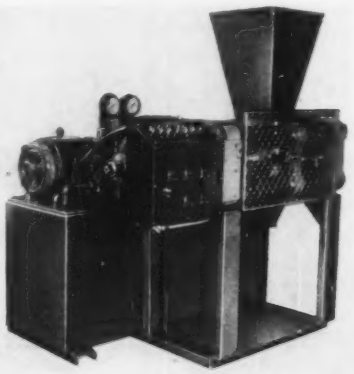
The unit consists of four major elements: a top cap with supply and outlet connections, a chamber with a drain cock at the bottom, a resin-impregnated filtering sleeve, and a water baffle.

Supply air enters through inlet ports, strikes a baffle plate on the cap, enters the chamber, passes through the filter, and leaves through the outlet port. Moisture drops to the bottom of the chamber and is drained off or blown out through the drain cock. The filter sleeve is reported to remove particles as small as 40 microns.

Filter capacity is 40 cu. ft./min. of air or natural gas; sump capacity is 12 cu. in.; filtering area is 21.2 sq. in.; and maximum working pressure is 1500 p.s.i. *The Foxboro Co., Foxboro, Mass.*

Hydraulic Cylinders—Redesigned series 750 fluid power cylinders have capacities (air or hydraulic) up to 750 p.s.i., while being relatively small in size. The objectives in redesigning the cylinders were: 1) to produce a compact cylinder of large capacity, 2) to incorporate a cushion design with positive adjustment, 3) to reduce friction to a minimum consistent with positive sealing, 4) to conform strictly to J.I.C. standards, and 5) to apply the latest information on corrosion resistance in the construction of the units. These objectives, the manufacturer states, have been met. See accompanying illustration for details of construction. *Hanna Engineering Works, 1751 Elston Ave., Chicago 22, Ill.*

Preformer—Hydraulic preforming machine has an electronically operated automatic control system, using plug-in type relays and cold cathode tubes to govern piston movement in increments of $\frac{1}{25}$ of a second. Hydraulic pressures can be dial-set for automatic operation. Safety controls automatically stop the machine in case of double stroking of preforms, lack of material, or over-filled tote boxes. Selective pressure range is from 0 to 125 tons on the die (either single or multiple cavities).



Logan's hydraulic preforming machine can produce pills up to 25 sq. in. in area and weighing up to 1¾ pounds

Preforms up to 25 sq. in. in area and 1¾ in. thick, weighing up to 1¾ lb., are reported to have been made of general-purpose phenolic with this equipment. Thickness and weight of pills are claimed to be controlled within ½ of 1 percent.

The machine is of horizontal design, permitting gravity feeding of material and gravity discharge of preforms. Moving parts and control panel are fully enclosed. *Logan Engineering Co., Hydraulic Div., 4901 W. Lawrence Ave., Chicago 30, Ill.*

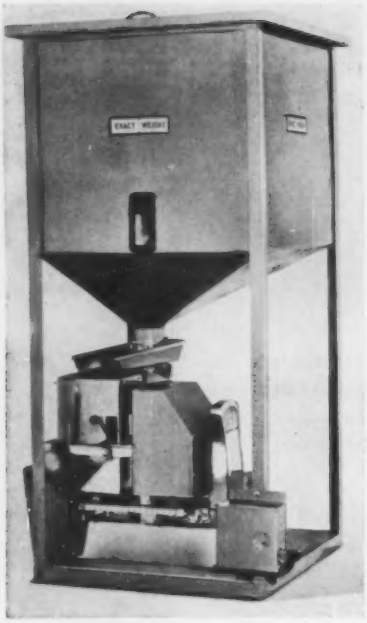
Mill—Model 52TC high-speed, three-roll mill can be used for either fixed or floating center roll operation. When differences in pressure between feed and take-off rolls are desired, the center roll is set in its fixed position. When equalized pressures are preferred, the mill can be converted to have a self-aligning or floating center roll. It is claimed that no special tools or skills are required for this change-over.

The apron of the mill is adjustable for raising or lowering knife contact point or varying apron angle on the front roll, and it is balanced to provide constant uniform pressure of knife on front roll as the knife wears.

The units are available in the following sizes: 4½ by 10 in., 6 by 14 in., 9 by 24 in., 12 by 30 in., 14 by 32 in., and 16 by 40 inches. *Charles Ross & Son Co., 148 Classon Ave., Brooklyn 5, N. Y.*

Weigh Feeder—Recommended for use on injection molding machines in the 50- to 100-oz. range, Model 273-F-O-IM-6 weigh feeder has a 3¾-lb. capacity weigh bucket and a 350-lb. capacity hopper, is adaptable to mounting on any make injection machine.

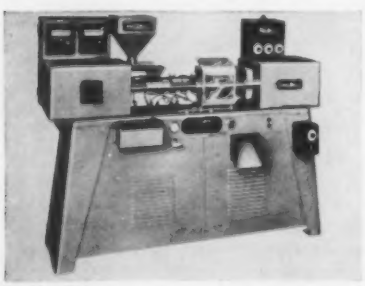
The scale unit of the feeder is an "Over-and-Under" Model 273 industrial scale, equipped with beam and poise in either metric or avoirdupois calibration. Metric provides either 100 g. on the beam in 2-g. divisions or 10 g. in ¼-g. divisions. Avoirdupois calibrations are available in a 4-oz. beam with $\frac{1}{7}$-oz. divisions or a 2½-oz. beam with $\frac{1}{1000}$-oz. divisions. Dials can also be calibrated to



Exact Weight Scale's weigh feeder has a weigh bucket of 3¾ lb. capacity and a 350-lb. capacity hopper

customer's specifications. The scale provides visible indication of every charge. Automatic compensators and other accessory equipment is available. *The Exact Weight Scale Co., 944 Fifth Ave., Columbus, Ohio.*

Injection Machine—Fully automatic, horizontal-type 2½-oz. injection molding machine, Model H-250, is claimed to have a plasticizing capacity of over 22 lb./hr., and attain up to 720 cycles/hr. (dry run). Injection plunger, transfer hopper, and oil cooler are water-cooled. The mold hydraulic mechanism of the machine makes it inoperative in cases where a molded part is not completely ejected. The unit is equipped with an automatic adjustable metering device.



Van Dorn's 2½-oz. Model H-250 injection machine has 22 lb./hr. plasticizing capacity, cycles at 720 shots per hour

Specifications for Model H-250 are as follows:

Injection capacity/shot (oz.)	2½
Plasticizing capacity (lb./hr.)	22+
Cycles/hr. (dry run)	720
Max. mold size (in.)	8 by 10
Mold clamping area (sq. in.)	20+
Max. mold thickness (in.)	8½
Min. mold thickness (in.)	3
Platen size (in.)	8 by 8
Mold clamping pressure (tons)	27
Mold opening (in.)	6
Hopper capacity (lb.)	20
Motor (hp.)	5
Machine size (in.)	79 by 26 by 58.

The Van Dorn Iron Works Co., 2685 E. 79th St., Cleveland 4, Ohio.

Blender — Continuous metering, blending, and dispensing of two liquid components is accomplished by the Blendometer, a unit designed for handling of base-catalyst plastics of the polyester or epoxy type. Metering of the components, in any ratio, is done through constant-displacement devices. After metering, the components travel through flexible hoses to a blending chamber located at the tip of a hand gun and are then dispensed through the hand gun nozzle.

The unit starts operating when a switch on the hand gun is closed: metering action is automatically initiated and the sequence of operations continues automatically.

The two components being blended, traveling along different hoses, are not in contact with each other until they reach the mixing tip, and since this chamber is small in size, material waste due to short pot life is said to be held to a minimum.

As stated by the manufacturer, the unit is easily calibrated to permit use of highly filled resins and is, in fact, being used in an operation where the base resin is filled with 15% (by weight), of ¼-in. fibrous glass, producing a putty-like material of stringy consistency.

There is said to be no limit to the amount of plastic which may be handled at one time, since the Blendometer may be coupled to material reservoirs of any size. The unit is available in a bench model which provides metered and blended resin through a single spigot, and also with rate-of-discharge controls which make it possible to increase or reduce at will the volume of material being delivered. *Mid-States Industrial Plastics Co., 18720 Grand River, Detroit 23, Mich.*

Coiling Unit—Claimed to be the only machine of its kind, Automat "140" can form either metal or plastic spirals at the rate of 650 ft./hr. in endless lengths with any pitch or diameter without the use of hot or cold water, steam, or infra-red lamps. The machine is said to be readily adjustable when switching from one material to another. *Plastic Loose Leaf, Inc., 209 S. Jefferson St., Chicago 6, Ill.*

Plastic Loose Leaf's spiraling unit can produce plastic spirals at a rate of 650 ft./hr. in endless lengths

Heating Equipment—Model 5000 dielectric heater for use with molding, laminating, extruding, foaming, gluing, drying, embossing, and other operations, is a portable unit with 5-kw. output. It is equipped with double-shielded cabinets, stated to reduce radiation considerably below the minimum required by FCC standards. *Resdel Engineering Corp., 2351 Riverside Dr., Los Angeles 39, Calif.*

Cooling System — Model 8-W Chil-er unit is a complete, packaged industrial refrigeration system, designed for continuous operation. All internal wiring, piping, refrigerant, pump, and recirculating tank are built in. The unit is said to deliver and recirculate cold water or brine at predeterminable volumes and

temperatures. The latter is reported to be controllable within ±2° F. Model 8-W is available in sizes from ½- to 150-ton capacity. *Mayer Refrigerating Engineers, Inc., Lincoln Park, N. J.*

Stamping Accessories—In order to be roll leaf stamped, most large hollow parts, such as radio cabinets, containers, etc., must be placed over a supporting fixture. An air-operated sliding bed with a 12-in. stroke, developed for use on the Kensol #100 stamping press, now carries this fixture under the head for stamping and out for loading and unloading. Both press and sliding bed are electrically dwell-timed.

Also made available is a 6- by 12-in. stamping head and roll leaf attachment for the standard 4- by 8-in. Model 100. *Olsenmark Corp., 124 White St., New York 13, N. Y.*

Inspection and Research Tool—A combination colorimeter-spectrophotometer, Spectronic 20, analyzes liquids and solids which transmit light by subjecting a sample to light of specified wavelengths. The degree of light transmittance is registered on a double scale, where readings may be taken in terms of either transmittance or optical density.

The instrument is designed for speedy operation by production line inspectors and laboratory technicians who need use only two control knobs in making routine colorimetric analyses. The instrument is also said to offer flexibility and high accuracy to research and quality control people concerned with the more complex analyses of spectrophotometry.

Effective range of the unit is from 375 *mmu* (near ultra-violet) to 950 *mmu* (near infra-red).

Basic components are a built-in grating monochromator, a photoemissive detector to pick up the light which passes through the sample and transmit it in the form of an electric current, and a printed circuit electronic amplifying system to build up the current so that it will register on the scale. *Bausch & Lomb Optical Co., 635 St. Paul St., Rochester 2, N. Y.*

Finishing Aid—Fragile injection molded plastics parts can be deburred and polished with Nylaslugs—molded nylon tumbling media. The

finishing operation varies with the product, but basically consists of using Nylaslugs with an abrasive of desired roughness. After thorough rinsing, they are used with a polishing cream, after which they are tumbled with clean hardwood dust. Nylaslugs come in various shapes and sizes, depending on the parts to be deburred and polished. *Rampe Mfg. Co., 3320 St. Clair Ave., Cleveland 14, Ohio.*

Welding Equipment — Designed for use in fabricating polyethylene and non-plasticized polyvinyl chloride, this thermoplastics welding kit contains an electrically operated hot-gas welding gun with fittings, flowmeters, tubing, contour marker for cylindrical components, porosity spark tester, plastic scriber, cutting knife, and other parts. It includes, in addition, two books on the subject of thermoplastic welding: "Welding of Plastics" and "Plastics Welding Manual." *The American Agile Corp., P. O. Box 168, Bedford, Ohio.*

Drill Unit—Self contained automatic drill unit, 24 series, requires only two outside connections — conventional shop air and electric power. An optional hydraulic accessory which controls the rate of feed is available for drilling hard materials at special angles or on curved surfaces. The hydraulic control can be taken out and replaced without the necessity of overhauling the complete drill unit. An auxiliary circuit, built into the unit allows synchronization of the stroke of the unit with indexing fixtures, sequence operations, etc. An electronic repeat cycle timer is available for deep hole drilling, to clear chips and to permit coolant to reach drill point in deep holes.

Series 24 drill units can be mounted by standard nose brackets in any combination—radial, vertical, opposed, or angular.

The drill units measure 8¾ in. in width, 15 in. in height, and 23½ in. in length, including the chuck. Weight, including the motor, is 88 pounds. Ten spindle speeds are available, ranging from 440 to 7400 r.p.m. Driven by a timing belt, units are available with either ½- or ⅓-hp. motor. Chuck capacity ranges from No. 60 drill to ⅜-in. bit. *The Dumore Co., Inc., Racine, Wis.*

BOOKS AND BOOKLETS

Write for these publications to the companies listed. Unless otherwise specified, they will be sent gratis to executives who request them on business stationery.

"Manual for Plastic Welding, Vol. II —Polyethylene," by G. Haim and J. A. Neumann

Published in 1954 by Industrial Publishing Co., 1240 Ontario St., Clevelnad 13, Ohio. 126 pages. Price: $6.00.

At the present time, there are two major methods of welding of plastics: gas welding, mainly applied to structural work, and high-frequency welding, mostly used for making household items, toys, etc., from plasticized polyvinyl chloride sheet. This manual, confined to gas welding, is aimed primarily at the practicing welder, although it does contain a certain amount of theory. It contains chapters on properties and commercial forms of polyethylene, welding equipment, details of the welding process, types of welds suitable for polyethylene, layout for a workshop for the welding of plastics, general rules for working polyethylene, lining tanks with polyethylene, polyethylene pipe lines, and others. Ten practice lessons are included.

"Guide for Safety in the Chemical Laboratory"

Published in 1954 by D. Van Nostrand Co., Inc. 250 Fourth Ave., New York, N. Y. 234 pages. Price: $4.25.

This handbook, prepared by and published for the General Safety Committee of the Manufacturing Chemists' Association, Inc., has as its stated purpose to set forth a basis for guiding laboratory personnel, students, and teachers in good safety practices in the handling of hazardous chemicals; promulgate general rules for the design and construction of a safe and efficient laboratory; indicate equipment and service facilities that are necessary in properly designed laboratories; outline precautionary methods and personal protective equipment; describe hazards presented by certain physical and chemical properties of materials; suggest first aid and medical treatments; and provide a reference to sources of safety information. The range of subjects includes handling of chemicals, protective equipment and devices, contamination control, etc., including those peculiar to radioactive materials.

"1953 Index to A.S.T.M. Standards."

Published in 1954 by American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa., 272 pages. No charge.

This annually published index serves as a reference guide for locating any A.S.T.M. standard in the bound volumes published by the Society. It also finds use in determining whether standards on any specific subject have been issued by A.S.T.M. 1124 standards and 872 tentatives, in effect as of December 1953, are indexed under appropriate key words. A list of standards in continuous numerical sequence of A.S.T.M. Serial Designations is also included. This list gives complete title and publication reference of each standard, and is especially useful when the A.S.T.M. designation of a particular standard is known. This index supersedes all previously published indices.

Dispersions—This six-page folder suggests that manufacturers of inks, polyvinyl chloride sheeting, cable coverings, etc., can cut production costs and eliminate dusting and contamination by utilizing custom facilities for pigment processing. The customer can have his own pigments dispersed in desired media, order a dispersion tailor-made to fit his specific requirements, or buy ready-made color concentrations off the shelf. *Acheson Colloids Ltd., Dispersed Pigments Div., Buckingham Ave., Trading Estate, Slough, Buckinghamshire, England.*

Phenolic spheres—Technical performance data on Microballoon, microscopic spheres made of phenolic resin and used in oil storage evaporation barrier applications, are presented in this 12-page booklet. It is stated that ½-in. floating layers of these hollow phenolic spheres have reduced crude oil evaporation losses by 80 to 90% in existing cone-roof storage tanks. Properties of Microballoon spheres and methods of installing them in crude oil storage tanks are presented. *Bakelite Co., a Div. of Union Carbide and Carbon Corp., 300 Madison Ave., New York 17, N. Y.*

Polyesters—A line of polyester resins, tradenamed Glykon, is described in this portfolio of three booklets. Booklet GPR-1 provides non-technical information on the resins, including a general description; application suggestions; compounding, molding, and fabricating methods; curing; release agents; and the like. Tables and graphs, giving physical properties, viscosity curves, catalyst formulations, etc., are appended. Booklets GPR-2 and GPR-3 contain, respectively, technical data on Glykon-R100 (rigid polyester resins) and Glykon-F600 (flexible polyester resin). These data include properties of uncured resin, properties of cured unfilled cast resin, etc. A price schedule and partial list of raw material suppliers (catalysts, promoters, glass fibers, glass cloth, fillers, pigments, mold release agents, protective films, and mold surface preparations) are also contained in the portfolio. *The General Tire & Rubber Co., Chemical Div., Akron, Ohio.*

Quality control—Concepts underlying and techniques used in statistical quality control are presented in this 52-page booklet. Based on case histories, the booklet covers such subjects as control charts, frequency distribution, sampling plans, statistical techniques, training programs, and others, using actual control situations as illustrative background. Those not familiar with statistical quality control techniques and applications will find this booklet a sound introduction to the subject. *Marchant Calculators, Inc., Oakland 8, Calif.*

Protective coatings—Bulletin No. 200 describes a line of vinyl resins for protective coatings, giving primer requirements for various types of surfaces, including rusty steel and old coatings. The bulletin also discusses, in a general way, some of the factors involved in vinyl protec-

—big juicer feature

The shatterproof new bowl on this powerful juicer is molded, complete with spout, from tough Tenite Butyrate. The gleaming white plastic withstands impact without chipping or peeling. It is also impervious to food acids, and won't rust or corrode. Light in weight, the bowl lifts easily off the motor base for a quick rinsing after use. Residue and solid particles wash right off its lustrous surface.

Today many familiar appliances rely on Tenite for durable containers, housings, handles or other parts. This versatile plastic comes in an endless range of colors, and can be rapidly molded or extruded to design.

For an illustrated booklet on Tenite properties and uses, write EASTMAN CHEMICAL PRODUCTS, INC., subsidiary of Eastman Kodak Company, KINGSPORT, TENNESSEE.

TENITE
BUTYRATE
an Eastman plastic

● Information regarding Tenite also can be obtained from local representatives listed under "Plastics—Tenite" in the classified telephone directories of the following cities: Chicago, Cleveland, Dayton, Detroit, Houston, Leominster (Mass.), Los Angeles, New York City, Portland (Ore.), Rochester (N. Y.), St. Louis, San Francisco, Seattle and Toronto—elsewhere throughout the world, from Eastman Kodak Company affiliates and distributors.

● Sweden Speed Juicer manufactured by Sweden Freezer Manufacturing Company, Seattle, Wash. Tenite Butyrate bowl molded by Plastal Specialties Company, Seattle.

tive coatings (e.g., surface bond, coating thickness, etc.) and presents results of spark and corrosion tests. Information on temperature limitations, weathering ability, and cost are also included. *Carboline Co. Div., Mullins Non-Ferrous Steel Castings Corp., 331 Thornton Ave., St. Louis 19, Mo.*

Brushes—This catalog lists a line of power-driven brushes for use in deburring, roughing, stripping, finishing, polishing, grinding, and similar operations. Illustrated are models up to 15-in. diameter, miniature sections to 1⅜ in. end brushes (including knot type, solid filled, and circular), and various models for special types of production work. *C. W. Morris Co., 10628 Cloverdale Ave., Detroit 4, Mich.*

Containers—Advantages of using plastics tubes and vials for packaging pills, powders, fishing tackle, small machine parts, jewelry parts, dental accessories, direct mail samplings, instrument parts, cutting tools, cosmetics, and similar small items, are delineated in an eight-page brochure entitled "How to Package Small Items." These include break resistance, light weight, printability, transparency, and variety of shape and size. *Lusteroid Container Co., Inc., 10 W. Parker Ave., Maplewood, N. J.*

Carrying cases—Nine carrying cases, fabricated of such material as high-impact vinyl, styrene copolymer, fibrous glass-reinforced plastics, and high-impact styrene, for use in housing cameras, projectors, sewing machines, dictating equipment, etc., are illustrated in this 4-page brochure as typical examples of work done in design and production. *Regal Plastic Co., 2800 E. 14th St., Kansas City 27, Mo.*

Spray painting—Catalog 956 gives information on a line of spray painting equipment, including spray guns, extensions and attachments, pressure and syphon cups, oil and water extractors, pressure fluid tanks and accessories, hose spray painting outfits, compressors, fluid handling pumps, paint circulating systems, spray booths, air supply and exhaust fans, automatic finishing equipment, and a wide range of fitting and accessories. A section is devoted to nozzles, with tables showing correct fluid and air nozzles, air requirements, and needles for each of a wide range of fluids, including standard paints, airplane dope, heavy materials, and adhesives. *Binks Mfg. Co., 3122 Carroll Ave., Chicago 12, Ill.*

Actuating systems—Bulletin 68123 provides data on a two-lever coordination control system for pneumatically actuated equipment and processes. The bulletin describes methods of arranging the latch and release mechanism of the system so that different types of coordination between the two levers will actuate a unit when, 1) both levers are operated simultaneously, 2) when the levers are operated in a given sequence, 3) when the levers are operated in an arbitrary sequence, and 4) when the levers are operated either simultaneously or in an arbitrary sequence. The bulletin also shows how dual units may be connected in series or parallel for safety and remote control purposes. Prices, specifications, capacities, operating forces, and mounting data are given. *Pantex Mfg. Corp., P. O. Box 660, Pawtucket, R. I.*

Custom molding—Facilities and products of a company specializing in custom molding thermoplastic and synthetic rubber O-rings, Teflon O-rings, Teflon back-up rings, and hydraulic packings to government and commercial specifications are depicted in this catalog. Engineering and design information is given. The catalog also describes a rubber-to-metal bonding process developed by the company. *Stillman Rubber Co., 5811 Marilyn Ave., Culver City, Calif.*

Surfacing—Step-by-step instructions for the installation of a high-pressure decorative laminate to flat horizontal or vertical surfaces (counter tops, backsplash, walls, around bathtubs, around windows, etc.) are given in this eight-page booklet addressed to the do-it-yourself enthusiast. Necessary tools and equipment are indicated. *Consoweld, Wisconsin Rapids, Wis.*

Colorant—Bulletin F-8259 lists technical information on acetoacetarylamides, used in the manufacture of organic pigments known as

hansa yellows and benzidine yellows. Physical and chemical properties, application suggestions, and shipping information are given. *Carbide and Carbon Chemicals Co., 30 E. 42nd St., New York 17, N. Y.*

Glass cloth—Details of a weave designated as High Modulus are outlined in this 8-page technical report. The weave was developed to eliminate, as far as practical, the crimped yarn condition inherent in standard weaves. The report presents results of comparative tests, using various glass fabrics with epoxy resins. Prices for the new fabric are included. *Textiglass, Div. of Cheney Bros., 92 Liberty St., New York 6, New York.*

Protective coatings—Three "memos," first in a series to be issued periodically, cover various phases of the field of plastisol protective coatings. Vol. I, No. 1, outlines the scope of the "memos"; No. 2 discusses use of protective coatings in the television industry (specifically, for TV tube conveyors); and No. 3 illustrates applications of coatings to large metal structures (exhaust hood funnels, manifolds). Future issues will be sent automatically to those working in fields where plastisol coatings find use who request to have their names put on the mailing list. A file folder for keeping the memos is also offered. *Arbonite Corp., 900 N. Main St., Doylestown, Pa.*

Acrylonitrile—This technical bulletin on vinyl cyanide lists properties, constant-boiling mixtures, specifications, and shipping data. The reactions of the compound (polymerization, copolymerization, cyanoethylations, reactions of the CN groups, and reactions of the double bond) as well as its applications (fibers, synthetic rubbers, plastics, textile treatment, paints, varnishes, enamels, plasticizers, adhesives, solvents, etc.) are included. *Carbide and Carbon Chemicals Co., 30 E. 42nd St., New York 17, N. Y.*

Melamine—Two technical bulletins discuss applications of melamine-formaldehyde resins. Bulletin No. 4 covers the subject of textile treating. It outlines the preparation of melamine-formaldehyde condensates (methylol melamine condensates and methylated trimethylol melamine) and describes the following applications: improvement of dimensional stability, crease resistance, and permanent stiff finishes; shrinkage and felting control in wool; and fixation of dyestuffs and delustrants. Bulletin No. 5 presents data on the use of melamine in paper treatment. It gives information on the preparation of melamine-formaldehyde resins (colloidal resin suspensions and sulfite-modified resins), on the method of application of resins to the paper, on method of curing the resins, and on the recovery of "wet broke." Selected references are included in each bulletin. *The British Oxygen Co., Ltd., Chemicals Div., Bridgewater House, Cleveland Row, St. James's, London S. W. 1, England.*

Fluorothenes—Property and fabrication data on fluorothene resins are compiled in this 16-page booklet. Recommendations on extrusion, injection molding, and compression molding are included. Fluorothene resins have high softening temperatures, resistance to burning, chem-

ical inertness, weathering and moisture resistance, good electrical and low-temperature properties. Applications include monofilaments for the textile industry, extruded wire and cable insulation, and numerous molded products. *Bakelite Co., a Div. of Union Carbide and Carbon Corp., 300 Madison Ave., New York 1, N. Y.*

Water conditioning—Practicing engineers and those who work with water-conditioning problems will find this latest edition of the "Water Conditioning Data Book" an invaluable reference guide. Tables, graphs, and computations cover mechanical details as well as such subjects as water impurities, chemical formulas of substances frequently appearing in the chemistry of water softening, reduction of alkalinity and noncarbonate hardness, and many, many more. *The Permutit Co., 330 W. 42nd St., New York 36, New York.*

Slitters and rewinders—This folder details a line of slitters and rewinders (formerly known as Jacques). Main drive of the units is through an electric clutch to provide even starts. Rewind arbors with and without individual tension control are described. Rolls up to 40 in. in diameter and 300 lb. maximum weight can be carried by the parent roll stand. The unwind shaft has both lateral and forward adjustments, as well as friction brake. Specifications for three models are listed. *Hobbs Mfg. Co., Salisbury St., Worcester 5, Mass.*

Products and services—Catalog GC-4-54 outlines the staff, operations, and products of a three-company organization specializing in furnishing materials, products, and engineering services covering nonmetallic materials for industry (plastics, reinforced plastics, rubber, felt, cork, asbestos, paper, etc.) Typical difficult jobs solved by the organization are cited. There are also two pages of A.S.T.M. and S.A.E. standards covering rubber. *Neff-Perkins Co., 2130 St. Clair Ave., Cleveland 14, Ohio.*

Plasticizer—Technical Bulletin 0-89 provides information on Santicizer 141, an alkyl aryl phosphate nontoxic, primary plasticizer for polyvinyl chloride and its copolymers and other resins. The bulletin con-

tains comparative performance evaluation data, suggested formulations, and information on properties imparted by the plasticizer (flame resistance, non-toxicity, low-temperature flexibility, grease resistance, heat sealability, and others). The plasticizer is recommended by the manufacturer for use in plastics products intended for contact with food or medical items, and in film, sheeting, textile coatings, plastisols, adhesives, packaging materials, and electrical insulation. The plasticizer has been approved by the Bureau of Animal Industry as non-toxic. *Monsanto Chemical Co., Organic Chemicals Div., St. Louis 1, Mo.*

Pentaerythritol—Technical information on pentaerythritol, a chemical used in the production of alkyd resins, rosin adducts, core oils, synthetic drying oils, plasticizers, surface active agents, and other materials, is contained in this bulletin. Details of formulations (including weights, prices, procedures, and characteristics) and methods of analysis (including reagents, procedure, apparatus, and calculations) are presented. *Celanese Corp. of America, Chemical Div., 180 Madison Ave., New York 16, N. Y.*

Extruders—This four-page folder describes a line of direct electrically heated extruders and associated control panels. The units are said to be produced with heavy wall sections and long extrusion cylinders (permitting greater heating areas); they are equipped with self-contained thrust bearings with high ratings and a speed transmission of adequate capacity for the drive requirements. The folder gives specifications for the entire line, ranging from 2- to 8-in. units. *Frank W. Egan & Co., Bound Brook, N. J.*

Vibration analysis—The relationship between vibration phenomena and precision manufacturing is discussed and illustrated in this 16-page booklet, which points out how unwanted vibration of rotating machinery parts affects production and what can be done about it. It goes on to describe equipment used in the localization and rectification of vibrations. This vibration-analyzing equipment, consisting of vibration pickup, probe, stroboscope, amplitude meter, and

(*To page* 196)

Investigate!

Fellows injection molding equipment

THE FELLOWS GEAR SHAPER COMPANY, Plastics Machine Division, Head Office and Export Department, Springfield, Vermont
Branch Offices: 319 Fisher Bldg., Detroit 2, Michigan • 5835 West North Avenue, Chicago 39, Illinois • 2206 Empire State Bldg., New York 1, N. Y.

frequency meter, can be used on operating machinery without removal of suspected parts. The analyzer locates the defective part in its natural setting, and is effective even for hidden machine parts. *International Research & Development Corp., 168 E. Hosack St., Columbus 7, Ohio.*

Phthalic anhydride—Technical Bulletin I-1 presents property and application information on tetrahydrophthalic anhydride. The material finds use in the production of plasticizers, resins, adhesives, chemical intermediates, and pesticides. The bulletin also discusses the more important chemical reactions of the anhydride and cites various literature references. *Allied Chemical & Dye Corp., National Aniline Div., 40 Rector St., New York 6, N. Y.*

Molds—Methods used in making mold cavities by electroforming, and cost and production advantages deriving from the use of molds made by this method in injection and compression molding, are discussed in a portfolio of four brochures. These brochures deal, respectively, with electroformed dies for three-dimensional moldings, electroforming and nylon moldings, electroformed hard-nickel molds, and the making of mold cavities by electro-deposition. *London & Scandinavia Metallurgical Co., Ltd., Tool Dept., Chelton Works, Gonsalva Rd., London S. W. 8, England.*

Products and services—Contained in this portfolio is a catalog of acrylic, polyethylene, polystyrene, and vinyl rod, sheet, and tubing, listing available sizes and prices. Also included is a four-page folder giving mechanical, electrical, thermal, chemical, and physical properties, and general characteristics of polyethylene, methacrylate, polystyrene, and Styrofoam. Information on fabricating facilities is also given. *Crystal-X Corp., W. Lenni Road, Lenni Mills, Pa.*

Postforming—A method for the determination of correct postforming temperatures in fabricating Formica and other high-pressure laminates through the use of marking sticks and liquids is described in this bulletin. Markings made with these sticks or liquids on the laminate melt at a given temperature (325° F.), giving the fabricator a visual indication that that temperature level has been reached. *Tempil Corp., 132 W. 22nd St., New York 11, N. Y.*

Do-it-yourself — Step-by-step instructions for applying polystyrene wall tile are contained in a booklet entitled, "Do it Yourself With Plastic Wall Tile." Directions are given for preparing walls, measuring to avoid unsightly sliver pieces, applying adhesive, using feature and cap strips, and fitting tiles around curved areas. *Monsanto Chemical Co., Plastics Div., Springfield, Mass.*

Overhead equipment—Booklet No. 2008-K presents engineering and application data on a line of overhead materials handling equipment, covering such topics as track drives, cranes, electrification, buckets, grabs, etc. *The Cleveland Crane & Engineering Co., Cleveland Tramrail Div., Wickliffe, Ohio.*

Dispersions—Forty dispersions of colloidal graphite, molybdenum disulfide, vermiculite, and zinc oxide are listed in this four-page folder. Typical applications, flash points, diluents, density, consistency, particle size, solids content, carrier, dispersed substance, and product designation are given for each dispersion. *Acheson Colloids Co., Div. of Acheson Industries, Inc., Port Huron, Mich.*

Controls—This folder on a line of automatic controls adaptable to manually controlled hydraulic compression presses, batch process machinery, or where cyclical operation is required, describes the application of timers, temperature and pressure controls, and air diaphragm motor valves to make the operation semi or fully automatic. *Seely Instrument Co., Inc., 377 Fourth St., Niagara Falls, N. Y.*

Reinforced plastics — A line of fibrous glass reinforced plastics molding materials and facilities for custom molding them into finished products are outlined in this four-page folder. *Erico Products, Inc., 2070 E. 61st St., Cleveland 3, Ohio.*

Anti-oxidant—Properties and uses of di-tert-butyl-para-cresol, trade-named dbpc, are discussed in two bulletins. Bulletin C-4-197 gives in-

formation, in non-technical language, on the use of dbpc in food, plastics, rubber, insulating oils, petroleum fuels, lubricants and waxes, and non-edible animal and vegetable oils. Technical Bulletin C-4-115 furnishes toxicological information, descriptions of chemical reactions, and commercial information on the product. *Koppers Co., Inc., Chemical Div., Pittsburgh 19, Pa.*

Fork trucks—This four-page reprint, entitled "Proper Operator Judgment Cuts Cost of Fork Truck Operations," discusses the correct methods of operator training. *Mercury Mfg. Co., 4044 S. Halstead St., Chicago 9, Ill.*

Sandwich—A high-strength, lightweight sandwich structural material is described in this 32-page illustrated brochure. *Goodyear Aircraft Corp., Akron 15, Ohio.*

Vacuum forming—This nine-page product data bulletin presents a technical discussion of the subject of vacuum forming. *Celanese Corp. of America, Plastics Div., 180 Madison Ave., New York 16, N. Y.*

Saws—A line of carbide-tipped saws for use in cutting acrylics, high-pressure laminates, and reinforced plastics are described in this four-page folder. *Radial Cutter Mfg. Corp., 831 Bond St., Elizabeth, N. J.*

Electron microscope—Design and operating information, as well as typical applications, for two types of electron microscopes are listed in this four-page folder. Data cover viewing screen, accelerating potential, magnification, electron diffraction, focus determination and control, image stability, resolution, and others. *North American Philips Co., Inc., Research & Control Div., 750 S. Fulton Ave., Mt. Vernon, N. Y.*

Correction

Certain portions of Table III, appearing in an article entitled "Properties of Plastics Films," published in the June 1954 issue of MODERN PLASTICS, are erroneous. *Low temperature impact* should be 7, *change in linear dimension* 8, *specific gravity* 9, and *flammability* 10. Specimens 6 were used for an aging test which had not been completed when the article was prepared.

Production of

FOR the purpose of this report, production is the sum of the quantities of materials produced for consumption in the producing plant for transfer to other plants

PLASTICS AND SYNTHETIC RESIN PRODUCTION
From Statistics Compiled

Materials	*Total p'd'n. first 5 mos. 1954*	*Total sales first 5 mos. 1954*
CELLULOSE PLASTICS:[a]		
Cellulose acetate and mixed ester		
Sheets, under 0.003 gage	7,267,805	6,982,844
Sheets, 0.003 gage and over	4,807,069	4,805,463
All other sheets, rods, tubes	2,317,196	2,069,117
Molding, extrusion materials	28,640,161	28,522,003
Nitrocellulose sheets, rods, tubes	2,859,079	2,296,053
Other cellulose plastics	2,251,279	1,835,617
PHENOLIC AND OTHER TAR-ACID RESINS:		
Molding materials[a]	81,676,829	71,316,762
Bonding and adhesive resins for:		
Laminating (except plywood)	26,581,949	17,618,778
Coated and bonded abrasives	4,030,598	4,210,124
Friction materials (brake linings, clutch facings, etc.)	6,275,993	6,051,673
Thermal insulation (fiber glass, rock wool)	12,513,557	13,115,253
Plywood	13,111,768	12,431,147
All other bonding and adhesive uses	5,984,865	6,136,306
Protective-coating resins	9,778,351	9,271,346
Resins for all other uses	10,846,111	9,076,868
UREA AND MELAMINE RESINS:		
Textile-treating and textile-coating resins	14,950,781	12,304,188
Paper-treating and paper-coating resins	8,675,218	7,190,403
Bonding and adhesive resins for:		
Plywood	30,904,042	27,488,470
All other bonding and adhesive uses, including laminating	10,294,410	9,025,082
Protective-coating resins	10,933,747	7,944,416
Resins for all other uses, including molding	28,449,433	26,001,732
STYRENE RESINS:		
Molding materials[a]	133,386,106	131,992,284
Protective-coating resins	34,456,501	33,822,701
Resins for all other uses	40,110,462	37,714,174
VINYL RESINS, total[b]	212,324,312	207,263,282
Polyvinyl chloride and copolymer resins (50 percent or more polyvinyl chloride) for:		
Film (resin content)		28,619,908
Sheeting (resin content)		28,239,495
Molding and extrusion (resin content)		56,435,940
Textile and paper treating and coating (resin content)[c]		21,871,332
Flooring (resin content)		8,663,153
Protective coatings (resin content)		9,066,231
All other uses (resin content)		11,483,550
All other vinyl resins for:		
Adhesives (resin content)		11,470,095
All other uses (resin content)		31,160,916
COUMARONE-INDENE AND PETROLEUM POLYMER RESINS	70,375,822	79,831,990
MISCELLANEOUS:		
Molding materials[a, d]	79,443,800	65,808,629
Protective-coating resins[e]	3,539,880	1,619,394
Resins for all other uses[f]	47,550,326	49,542,592

* Dry basis is designated unless otherwise specified.
** Partially estimated. † Revised.
[a] Includes fillers, plasticizers, and extenders. [b] Production statistics by uses are not representative, as end use may not be known at the time of manufacture. Therefore, only statistics on total production are given. [c] Includes

Plastics Materials

of the same company, and for sale. Sales include only the quantities involved in bona fide sales in which title passes to the purchaser.

IN POUNDS* FOR APRIL AND MAY 1954
by U. S. Tariff Commission

*April***		*May***	
Production	*Sales*	*Production*	*Sales*
1,436,261	1,355,999	1,439,277	1,403,325
823,313	908,746	935,486	873,630
456,101	376,976	437,340	398,781
6,477,706	6,312,844	5,369,842	5,392,798
553,800	431,916	482,877	379,248
427,994	334,889	400,549	300,774
15,326,978	14,129,538	16,360,260	13,237,745
5,502,029	3,704,856	5,118,846	3,368,568
729,291	875,323	967,288	798,591
1,436,234	1,284,957	1,524,212	1,275,504
2,527,045	2,486,220	3,065,077	2,960,790
2,560,759	2,367,357	2,764,991	2,515,539
1,081,143	1,144,954	851,253	954,917
1,949,877	1,947,284	2,212,966	1,876,688
2,403,563	1,964,153	2,152,777	1,852,788
2,986,009	2,831,836	2,856,271	2,740,237
1,592,857	1,523,006	1,852,728	1,340,077
6,901,878	6,881,334	5,998,192	5,390,588
1,554,314	1,707,311	2,081,943	1,459,503
2,332,053	1,875,798	2,137,180	1,596,687
4,856,971	5,063,150	5,840,781	5,038,478
28,818,716	29,291,082	26,571,647	23,986,936
7,290,918	7,288,166	7,450,521	7,177,353
8,070,456	8,390,533	8,467,038	7,782,194
†43,412,923	†44,700,114	42,163,263	39,510,320
	6,457,255		4,774,708
	6,454,798		3,839,635
	12,568,175		11,096,175
	4,479,101		3,582,239
	1,894,201		3,256,144
	1,863,649		1,730,486
	2,311,021		2,643,190
	†2,407,153		2,577,888
	6,324,761		6,009,855
16,528,868	16,837,785	14,102,933	14,108,963
15,584,094	12,449,425	15,396,985	12,849,213
1,843,894	328,359	317,514	291,648
9,863,454	10,205,883	10,099,439	10,243,663

data for spreader and calendering-type resins. [d] Includes data for acrylic, polyethylene, nylon, and other molding materials. [e] Includes data for epichlorohydrin, acrylic, polyester, silicone, and other protective-coating resins. [f] Includes data for acrylic, rosin modifications, nylon, silicone, and other plastics and resins for miscellaneous uses.

Paper Bail

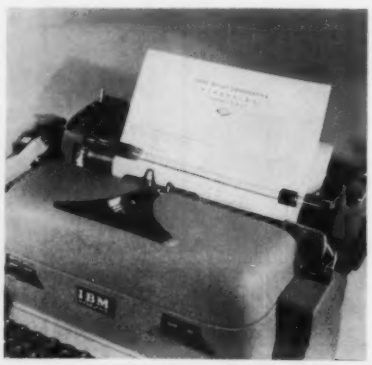
WHILE not the most serious problem confronting the busy typist, the fact that the paper bail of a typewriter always hides one or two lines of type and has to be raised in order to refer to parts of manuscripts or letters just typed and still in the typewriter, has in the past proved to be both annoying and time-consuming.

A transparent paper bail has now been developed which contributes to improved office efficiency by eliminating this bothersome "blind spot" in typing.

Fabricated of extruded rod, the new bail is made of COCOR CR-39 allyl diglycol carbonate, an optically clear thermoplastic material. CR-39 was chosen for this application for a number of reasons. In addition to its optical clarity—which makes typed lines fully visible and easy to read—CR-39 has outstanding resistance to surface abrasion, will not craze when subjected to contact with solvents (such as typewriter cleaning fluids), and exhibits impact resistance characteristics superior to those generally found with glass.

The new plastic paper bail can be easily installed in a few minutes on typewriters presently in use, using no other tool than a screwdriver. Once in place, it not only helps to improve office efficiency, but also adds to the appearance of the machine by giving it that clean, uncluttered, modern look.

CREDITS: Transparent plastic paper bail developed and marketed by Maroth-Kennedy Corp., Greenwich, Conn., using COCOR CR-39 extruded rod supplied by Cast Optics Corp., Riverside, Conn.



Optically clear allyl-base typewriter paper bail improves typing efficiency

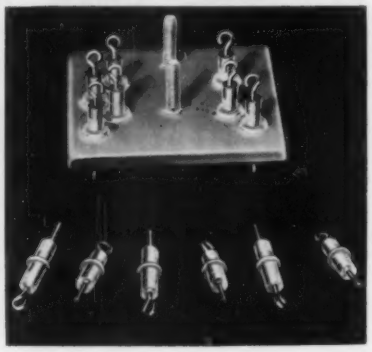
Molded Fluorocarbon Applications

THE recent introduction of two industrial products successfully molded of fluorocarbon takes advantage of the unusual physical and chemical properties of the material for opening new application possibilities.

Both new products—a series of terminals molded of Kel-F fluorocarbon and a line of transparent oil sight glasses also molded of Kel-F fluorocarbon—are claimed to perform more efficiently under severe operating conditions than has heretofore been possible. The molded fluorocarbon terminals, for example, boast a higher current capacity and longer life than conventional hermetic-seal terminals. They are able to handle 15-amp. current at more than 2000 volts r.m.s. without corona and can go up to more than 7500 volts r.m.s. without producing flash or tracking.

Because of the resistance of fluorocarbon to heat and cold, the new terminals offer perfect insulation at temperatures as low as —148° F. and as high as over 300° F. In addition, the fluorocarbon insulation will not age, shrink, or swell.

When the terminals are in use, the excellent dimensional stability of the material prevents loss of hermetic seal under high mechanical stress and their high tensile and shear strength eliminates the danger of insulation failure under thermal cycling. The chemical inertness of fluorocarbons in the presence of chemicals, oils, and vapors, also eliminates any environmental restrictions on the use of the terminals. Zero water absorption and "non-stick" characteristics provide a high level of insulation resistance under conditions of high humidity or where conductive fungus growths in the finished product are problems which have to be considered.



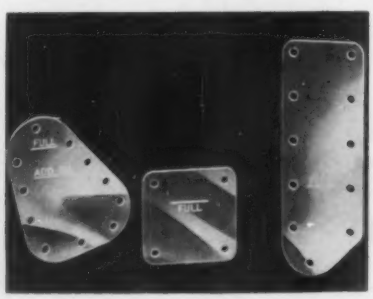
Molded fluorocarbon terminals have high current capacity and long life

The oil sight glasses—the second new application—are machined from molded fluorocarbon sheets up to ¼ in. thick. The glasses are claimed to remain transparent indefinitely, and will resist corrosion, extreme temperatures, shock, and vibration. They are currently being used on transmission housings in helicopters, but possible adaptation to the food, chemical, and drug processing industries is also currently under active investigation.

Many of the properties of fluorocarbon that make the material so effective for use in the terminals play a similar role in this application. Oils, sludges, and acid products have no effect on the chemically inert material at the required operating temperatures of —65 to 300° F. The exceptional high compressive strength and resiliency of fluorocarbon permit mounting bolts in the glasses to be pulled tight (as a safeguard against leakage) without immediate or eventual shattering or cracking.

In addition, the material will not shrink, swell, nor lose its transparency upon exposure to the elements. The "non-stick" characteristics of fluorocarbon enhances the utility of the glasses by preventing the accumulation of deposits and thereby reducing the need for frequent cleaning.

Oil sight glasses molded of fluorocarbon will remain transparent indefinitely



CREDITS: Terminals molded by Brilhart Plastics Corp., Mineola, N. Y., and glasses by Nichols Engineering, Inc., Stratford, Conn. Kel-F fluorocarbon supplied by M. W. Kellogg Co., subsidiary of Pullman, Inc., Jersey City, N. J.

Polyethylene fitment and phenolic closure improve sauce-dispensing bottle

No-Drip Fitment

WORCESTERSHIRE SAUCE bottles, which for generations have been topped with glass stoppers and shell cork liners, have now been given molded polyethylene shake-top fitments and molded phenolic screw-on caps.

Use of the glass-cork closure arrangement entailed a number of disadvantages. Among these were the facts that the amount of condiment dispensed and its direction of flow could not be easily controlled, that sauce often dripped down the outside of the bottle after use, that after some time the cork liner often assumed an unappetizing appearance, and that in case the bottle tipped over the glass stopper might come loose and release the contents of the bottle.

With the adoption of the polyethylene shaker top and the phenolic closure by R. T. French Co., Rochester, N.Y., one manufacturer of the sauce, all these problems have now been overcome.

The polyethylene fitment, which slips over the neck of the bottle, has a restricted center orifice, with or without baffle, to direct and control the flow of the product, yet permits rapid filling of the container. It has good cut-off characteristics to prevent the contents from dripping after dispensing. Its appearance is neat and clean, even after prolonged use.

CREDIT: Polyethylene fitments and phenolic closures molded by Owens-Illinois Glass Co., Toledo, Ohio.

Vinyl Laminate

DECORATIVE vinyl laminate sheets with a sparkling jewel-like effect are bringing new life, beauty, and style to a variety of consumer goods.

Supplied in rigid or flexible form, the laminate, called Spark-O-Loid, can be wrapped around cigarette lighters, cemented to the tops of vanity cases, electronically heat sealed to wallets, or used in a variety of other ways to add new styling to various personal accessories. The biggest outlet for the material, however, is expected to be in the garment field, where it will be used in fabricating ladies' handbags, evening bags, and belts. One manufacturer is currently experimenting with a fashionable lady's shoe for evening wear that will be fabricated from the decorative laminate.

In the manufacture of the laminate, three separate sheets of vinyl are used. The first sheet is covered with a glass or metal "sparkle" material in silver, gold, or multi-color combinations. On top of the sparkle sheet, a transparent vinyl sheet, lithographed on one side with an attractive open pattern, is placed. Finally, a third sheet, transparent vinyl about 0.0015 in. thick, is placed over the printed sheet. The combination is then put into the laminating press and formed into a single sheet under heat and pressure.

The back of the laminate can be supplied in a polished or dull finish, depending upon the end use to which it will be put. The front of the sheet is, of course, highly polished. According to the manufacturer, the material can be supplied in thicknesses ranging from 0.025 in. up to ¼ inch.

CREDITS: Spark-O-Loid made by The Emeloid Co., Inc., Hillside, N. J., using vinyl sheet supplied by Bakelite Co.

Cigarette lighter and vanity case are dressed up with decorative laminate

Molded nylon bushing (left) improves performance of air-powered drill

Nylon Bushing

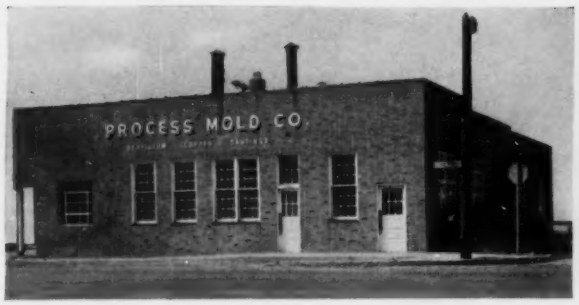
BY INTRODUCING a splined bushing molded of nylon into a hydraulically controlled, air-powered drill, a damping effect has been provided between power supply and spindle which is claimed to considerably lengthen the life of the drill point. This improved operation is attributed to the fact that the resilient nylon bushing will reduce the amount of shock and vibration while the tool is in use by almost 40 percent.

The bushing, which is located at the back end of the drill, is designed to accommodate a revolving metal spindle or shaft that passes through an opening in the center of the bushing. Taking advantage of nylon's easy moldability into complex shapes, the manufacturer of the drill has increased the bearing surface of the spline by adopting a polygon-ground triangular drive for the opening. This triangular shape increases the bearing surface of the spline by approximately 60%—providing maximum efficiency for power transmittal. At the same time, nylon's low coefficient of friction permits easy passage of the spindle through the triangular opening.

The added bearing surface of the opening coupled with the damping property of the nylon also serves to effectively cut down the chatter of the tool during operation.

According to the engineers and designers responsible for the drill, the successful use of nylon for this application may be the forerunner to an increased use of molded nylon parts to improve the operating efficiency of similar power tools.

CREDITS: Drills are manufactured by Alkon Products Corp., New York, N. Y.; nylon supplied by E. I. du Pont de Nemours & Co., Inc.



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In your next mold . . . . recommend

Beryllium Copper cavities

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19665 Schoenherr Avenue Detroit 5, Michigan

NATIONAL FORGE *Impact Tester*

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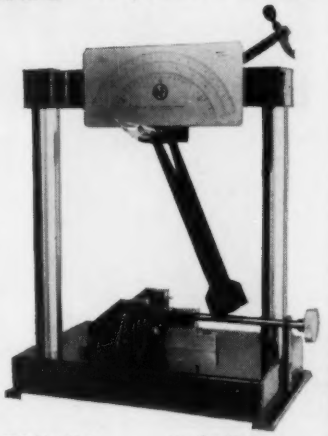

- Combined Izod and Charpy.
- Massive, open-working-clearance design, with wide linear scales accurately calibrated.
- Two capacity combinations are available: **Model TM 52004,** 3 ranges, 30 foot-pounds maximum capacity.

  Model TM 52010, 3 ranges, 10 foot-pounds maximum.

Height—36 in.
Width—28 in.
Depth—16 in.
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Light for Ironing

AS AN extra convenience feature for the housewife, a built-in, movable lamp molded of snow-white urea has been installed on the 1955 models of the Kenmore "Tip-Toe-Matic" electric iron. The one-piece fixture serves as both lamp arm and shade and is attached to the iron body in such a way that it can be easily swung out over the ironing area, providing good illumination without interfering with the movement of the iron.

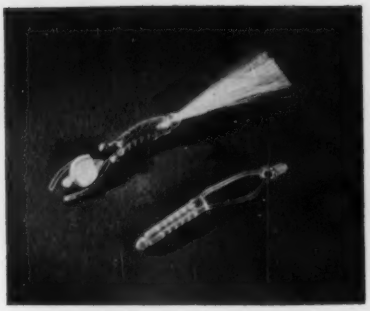
In choosing a material for this application, the manufacturers report that urea was the popular selection primarily because its resistance to the heat of the incandescent bulb prevents any possibility of distortion of the shade. The near opacity of the molded piece also helps provide good light dispersion and reflection—two factors of importance in assuring eye comfort.

In addition, the rugged molded urea lamp has a lustrous hard surface which is both attractive and easily kept clean; its integral coloring won't chip or peel off; and it has excellent dimensional stability.

Since the one-piece fixture is complete in itself, assembly to the body of the iron is relatively simple. A molded-in hole at the foot of the lamp arm accommodates the fastener that holds the unit in place on the iron.

CREDITS: Lamp designed by Whirlpool Corp., manufacturers of the Kenmore ironer for Sears, Roebuck & Co. Unit is compression molded by Modern Plastics Corp., Benton Harbor, Mich., using Beetle urea-formaldehyde material supplied by American Cyanamid Co.

Molded-in rib sections add to strength of urea electric iron lamp housing



Fishhook and nylon tail turn vinyl hair curler (bottom) into fishing lure

Fishing Lure

UTILIZING the shape and physical properties of a conventional vinyl hair curler, an ingenious new spinning lure for use in fresh or salt water has been introduced to fishing enthusiasts.

The basic appeal of the unit as a fishing lure is its life-like resemblance to the succulent Florida shrimp—favorite food for many varieties of fish. The body of the lure is actually made from an ordinary vinyl hair curler, selected for this application because of its toughness, flexibility, resistance to mold and mildew, and the fact that its long, narrow shape closely approximates that of the shrimp. In making the lure, the hair curler is reversed and the hook is inserted through it. A nylon tail is then inserted into one end of the body and three additional parts, which are designed to simulate the head and eyes of the shrimp, are inserted into the other end.

To add to the "live" appearance of the lure, the ends of the curler's hair holding loop are clipped off, leaving two flexible "fingers" that resemble the waving antennae usually found on shrimp or crawfish. These feelers also help keep the hook from fouling in sea weed or grass.

As a final touch, a series of tiny air holes is cut into the vinyl body. When the spinner is pulled through the water, these holes create a stream of air bubbles.

Because of the outstanding resistance of vinyl to moisture and sea water, the lures can be used in any body of water for spinning, jigging, plugging, or trolling.

CREDITS: Lures marketed by Woolfie Lures, Inc., Miami Beach, Fla.; vinyl for curlers supplied by Bakelite Co.

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PLASTICS MARKING. Reprint gives detailed information on the techniques of marking plastics and metals. Illustrates and describes various marking machines and their features. The Acromark Co. (I-421)

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Plastics Tools

(*From page 95*)

Mich., for making tools, dies, and fixtures from epoxy resins.

The surface of the model is first highly polished and a parting agent is applied. A build-up to the height required to contain the back-up or core is then installed. This build-up should also be waxed and coated with a parting agent.

A core or back-up material which has previously been constructed is suspended in the build-up approximately ¼ in. from the model and sides of the build-up. Pouring spouts of approximately 2 in. in diameter should be provided.

The special surface coating formulation of epoxy is then thoroughly mixed and the catalyst added during the mixing operation. It is estimated that approximately 90 lb. of resin are required for each cubic foot of volume. Using the pouring spouts, the resin is poured, starting at the lowest point or points, until the liquid resin has risen to the top surface of the core. If there is danger of trapping air at certain low points, it is necessary that vent holes be provided in order to eliminate the formation of voids.

Figures 27 through 33 show several dies produced by this method. The cast epoxy forming die illustrated in Fig. 30 is running in one of the major automobile plants and, to date, has produced 7000 steel panels without reworking of any kind. It is still in production. The cast epoxy draw dies shown in Figs. 31 through 33 have already produced over 15,000 metal parts for the Clinton Machine Co., manufacturers of outboard motors, with no deterioration to the die being evident.

Automobile Industry

All the automotive metal working plastic dies at the Automotive Body Div., Chrysler Corp. are made by a technique in which the glass cloth which is used on the face is backed up with 2-in. chopped fiber that serves as the core. The composition of the finished die is approximately 50% glass and 50% polyester resin by weight.

In making a plastic draw die of this type, work is generally carried on directly from the die model, but prototype panels can also be used if they are suitably supported to withstand a pressure of 20 p.s.i. Assuming that a die is to be built from a wood model, the first step would be to establish a wooden or plastic ring line, and then box the entire model in so that the model forms the bottom of the box. All surfaces are then coated with a mold release, such as paste wax.

The volume of the die is next estimated so that the proper proportions of chopped fiber, cloth, and resin can be weighed out. All the polyester resin to be used for the entire die is mixed simultaneously, using cobalt naphthenate and MEK peroxide as the curing agents. The face of the die is then laid up with cloth and resin. The cloth is first cut into patches suitable for easy presaturation with resin, after which the box is filled with 2-in. chopped fibers, 50% pre-saturated with resin, and the entire lay-up is covered with a wooden plug which just fits inside the box. The plug is forced into the box under a constant pressure of 20 p.s.i. until the resin cures. Through the use of pressure while the dies are going through the gel stage, shrinkage can be controlled.

Once one section is made up, the successive sections are cast to it. Whenever metal thicknesses are required, a prototype panel of the desired dimensions can be made from glass cloth and polyester or epoxy resin, or sheet lead may be used. Automotive die models are made to the inside of metal so that it is always necessary to build up the panel clearance on the model before beginning the plastic lay-up.

In cases where extreme conditions of wear are encountered, such as sharp corners or deep draws, metal inserts are pre-fitted to the model and cast into the die face. At times, metal is added to the die after it has been completed in order to strengthen areas which will have to endure extreme wear conditions. When all sections of the die have been made, they are placed in a 200° F. oven for a short period of time to insure a complete cure.

The Future

Tooling plastics are out of the experimental stage and are being used today on an extensive scale. This does not mean that plastics tooling has replaced metal tooling. If the advances over the past several

years continue, however, an enthusiastic user of plastic dies predicts that 75% of all dies in the automotive industry now made in steel will be made from plastic. To point this up, it might be well to indicate the actual production figures supplied by the Automotive Body Div., Chrysler Corp., of the number of plastic dies manufactured over the past two to three years. To date (these figures are four months old), this division of Chrysler has made approximately 320 hydroform dies, 80 draw dies, 70 restrike dies, and 60 stretch dies. In addition there have been over 100 plastic templets and 400 various types of fixtures, such as drill and checking units, made from plastic materials. Most of these tools have been in production for the past two years.

The aircraft industry is another fertile field for plastic tooling. Grumman, for example, has converted 100% to plastic as far as their stretch dies are concerned. Lockheed Aircraft Corp. is currently producing some 15 of their most difficult stainless steel and aluminum alloy aircraft parts with plastic dies. They report that the tool cost has been reduced to one-third that of the previously used material, and production time to one-fifth. Lockheed has also eliminated 5000 man-hours per month previously required for production and maintenance of lead die punches. They further report that the quality of production is far better since "wrinkles" have been completely eliminated from the formed parts.

Basic Resins

The three basic resins in use today—phenolic, polyester, and epoxy—are used either separately or in combination with each other. Dies are made from these resins and their combinations by several different methods. This is a healthy condition even though the opinions of the experts in the many different companies are widely divergent as to the best material or the best method to be used.

Since all of these materials and methods are being used in actual production, the advantages and shortcomings of each should soon become evident. There is little doubt that as the scoreboard continues to record the success and the failures of various materials and techniques, those companies and individuals who have a big interest in this new field will be quick to take advantage of the facts unfolded by such progressive engineering research.

Acknowledgments

It is difficult for the editors of MODERN PLASTICS to give due and proper credit to the many men who have aided in the preparation of this article. Heartfelt thanks are extended to the following men without whose cooperation this article would not have been possible.

John R. Charlton—Ciba Co., Inc.; John Koons, Fred Lyijynen, Al Prance—Chrysler Corp.; Elon Anderson, Bryon Brown—Grumman Aviation Engineering Corp.; Dr. J. W. Donnell, Paul A. Ritchey—Kish Resin, Inc.; W. T. Bowcott—McDonnell Aircraft Corp; W. R. Weaver—Modern Pattern & Plastics, Inc.; James Renaud, George M. Rice—Ren-ite Plastics, Inc.; Benjamin Sokol—Republic Aviation Corp.; George C. Adams, L. R. Miller—Rezolin, Inc.—END

Spectacular

(*From page* 107)

glass cloth and mat strips, about 6 by 38 in. in size, were manually laid up until the desired thickness had been reached. Thickness varied according to the degree of structural strength required. The top of the cab, for example, which would have to bear the weight of piled-up snow needed 3 to 4 layers of mat and cloth; the side of the cab needed only 2 to 3 layers.

Curing of the lay-up was carried out at room temperatures for about 1 to 2 hours. The plaster production molds were then broken up and the cured reinforced plastics parts were removed in one piece and placed in position over the metal skeleton frame which had been used earlier in building the original plaster model.

To secure these parts permanently in place—without the necessity of drilling or bolting—reinforced plastics "straps" were used. These straps are actually strips of fibrous glass that had been laid up over parts of the metal frame, impregnated with resin, and allowed to cure as an integral part of the plastics body.

Molding of the wheels followed a similar production pattern. The single magnesite mold that was used for all six wheels was cut into six separate sections prior to lay-up so that it could be easily disassembled to allow the wheels to be removed in one piece. During lay-up, the six sections were mechanically clamped together as a single unit.

After the wheels had been strapped in place over the metal frame, all of the plastics parts—both cab and wheels—were smoothed down by grinding and sanding, painted, and assembled to the aluminum trailer. A series of 52 holes molded around the inside rim of each wheel accommodates sockets and bulbs. When the display is lit at night, these bulbs alternately light up in sequence to simulate moving wheels.

CREDITS: Truck designed for Yale Transport Corp., by The Artkraft Strauss Sign Corp., New York, N. Y. Truck cab and wheels molded by Cinderella Mannequin C[illegible], New York, N. Y., using fibrous glass supplied by Owens-Corning Fiberglas Corp. and Hess, Goldsmith & Co., Inc., and Marco polyester resins supplied by Celanese Corp. of America.

Color in Resin-Rubber Plastics

(*From page* 114)

temperature requirements are sometimes within the proper range.

Iron oxides are not recommended as they do not possess the proper heat stability. Color streaking develops because of lack of heat stability.

Maroon

Cadmium maroons are recommended, but the high percentage of selenium makes these pigments very expensive.

Indanthrene maroons are both light and heat stable within the required temperature range. However, these pigments are even more expensive than the cadmium maroon.

Orange

Several shades of cadmium orange are available. It is also possible to use a cadmium red and a cadmium yellow.

Yellow

Cadmium yellow is recommended for the same reason cadmium reds and orange are used—superior heat stability.

Cadmolith yellows are also used. These are cadmium yellows "let down" with lithopone to a ratio of $\frac{1}{3}$ cadmium to $\frac{2}{3}$ barium sulfide. Such colorants are especially useful when tints or very small amounts of yellow are required.

Iron oxide yellows tend to be very muddy and weak in tinting action. Stability is questionable.

Chrome yellows have been widely used, but these pigments have poor light stability and only fair heat stability.

Green

Phthalocyanine greens are recommended as they are stable to heat and light and give clean brilliant colors.

Chrome oxides are very dull shades but satisfactorily stable.

Blue

Phthalocyanine blues are the best. They have light stability and give clear brilliant color. However, some trouble has been experienced with heat stability.

Indanthrene blues are very expensive, but they are light and heat stable.

Ultramarine blues were found to be very poor in outdoor aging. They are weak and not too brilliant in tint.

Brown

Iron oxides give fair results, but they tend to lower impact strength, especially at low temperatures, and give poorer aging. Heat stability is borderline at best. For maximum heat stability it is often desirable to use a cadmium red and a black to produce the brown desired.

White and Black

Rutile titanium dioxide types are the best whites as they give maximum color stability after heat, light, and weather exposure.

Anatase titanium is whiter and has somewhat better hiding power but is less chalk resistant.

Carbon blacks are recommended and have proved very satisfactory.

Lamp blacks have also proved very satisfactory.

Bone blacks, because of coarser particles, have had some harmful effects on properties.

Gloss is closely related to color and it is often impossible to produce the proper color without the proper gloss. Many of these copolymers can be buffed to a very high gloss. Buffing is also made possible because colors are not a surface effect, but dispersed in the materials.

Color possibilities can be expanded by the use of synthetic finishes or lacquers. These systems are already used on other plastics such as polystyrene and can be economically applied.

A primary function of color is sales appeal, yet color can also influence product performance. The acrylonitrile resin-rubber blends require the most heat stable pigments for injection molding and extrusion. Sheet stock is not quite so critical. The service life of the molded piece should be considered when selecting a color. Under given conditions some pigments will give more satisfactory product service than others. In these cases, the color should be dependent on the service expected.—END

Cellulosics Color

(*From page* 116)

such materials. These conditions include particle size, brightness of the metallic powder when dispersed in the plastic material, and whether or not the metal will darken or change color with age. It is generally true that metallic powders which produce very bright colors in lacquers and paints will not produce a color of equal brightness when incorporated in cellulose ester plastics. This is due mainly to the heat involved in processing and molding the plastic and to the fact that the particles of metal are covered to a greater depth than is the case with coatings of lacquers or paints.

Variegated color effects with cellulose ester plastics, while not a function of basic coloring, are very popular and worthy of mention in this article. The configuration of colors described in a variegation, or mottle, as they are sometimes called, is the result of a blending or running together of two or more colors when molded together. Plain colors are used and the proportions of each that are necessary to achieve a desired variegation are usually recommended by the manufacturer. By obtaining the component colors separately, the molder is able to control the variegation by adjusting the relative proportions of each color. The configuration obtained in the finished article is influenced by the size of the molded piece and by the size of the nozzle, sprue, runners, and gate, as well as by molding temperatures and the speed at which the plunger travels on its forward stroke. Blending or mixing of the colors in a variegation is influenced also by the relative flow-hardness of the component colors. The base color, that is the one that is to be predominant in the variegation, usually is of a softer flow than the other color or colors, which are referred to as "fillers." Within limits, compensation for different molding conditions can be accomplished by varying the proportions of the component colors. For this reason it is well to mix first a small quantity of component colors in the proportions recommended and then mold them on a trial basis.

In the softer range of flows of some cellulose ester plastics, there is

a tendency, usually at elevated temperatures and humidities, for plasticizer to exude or migrate to other materials such as lacquers. This is due to the plasticizers having greater affinity for the base materials of the lacquers than they have for the cellulose esters. This is particularly true when lacquers of half-second nitro-cellulose base are used as protective coatings or decoration on these plastics in the softer flow range. When this phenomenon occurs with some dye-colored materials, the plasticizer carries some of the coloring agent with it into the lacquer, causing a staining or discoloration commonly termed "bleeding." Likewise, when some cellulose ester plastics are used in contact with certain other materials such as rubber, vinyl elastomers, and other thermoplastics, either the cellulosic plastic or the other material may discolor. However, since either the cellulosic plastic or the other material may be compounded with pigments or nonbleeding-type dyes or additives that will not migrate, these problems can usually be avoided if considered in advance of ordering the materials.

Due to the fact that the various types of lacquers suitable for use on cellulose acetate butyrate plastic considerably outnumber those available for use on the other cellulosics, this plastic is extremely popular for lacquered applications. This is evidenced by its extensive use for dolls, fish lures, duck decoys, football helmets, and advertising novelties such as pens, pencils, etc. Cellulose acetate butyrate requires considerably less plasticizer to obtain a given degree of flow, and the smaller the quantity of plasticizer used, the better it is retained in the plastic. Also, it is possible with cellulose acetate butyrate to use plasticizers that have higher boiling points, lower vapor pressures, and greater compatibility with the ester than those suitable for use with cellulose acetate. These characteristics of cellulose acetate butyrate permit use of a wider range of solvents, diluents, and base materials in producing suitable lacquers for it. Cellulose nitrate, alkyd resins, and most of the common lacquer-base materials may be used.

Although the cellulosics in general lend themselves readily to metallizing by high-vacuum deposition, the qualities of cellulose acetate butyrate plastic discussed in the previous paragraph, make it particularly well adapted to this process also. Colored cellulose ester plastics that are to be metallized by high vacuum must be made with non-volatile coloring agents and the smallest quantities possible of the most compatible plasticizers in order to avoid excessive evacuation, or "pull-down," time in the vacuum chamber. Many attractive color effects can be obtained by metallizing. For example, an escutcheon or medallion molded of amber-colored transparent plastic and metallized with aluminum on the back surface will produce a very bright gold color effect of pleasing depth when viewed through the front surface. Similar color effects may be obtained by metallizing articles molded of clear-transparent plastic, applying a coating of tinted or colored lacquer of a thermosetting type, and then curing the piece in an oven.

The actual processing methods for adding coloring agents to cellulose ester plastics are somewhat conventional and present no particular problem.—END

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Metallized

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ed on the use of the metallized materials for realistic reproductions of metal consumer goods—from cigarette lighters to coffee pots.

In fields other than signs and displays, the ease with which metallized sheets can be vacuum formed has opened the door on a host of new end-use possibilities. Clock faces, for example, have for several months been an important outlet for silk-screened flat metallized plastics sheets. Now, with several manufacturers considering the possibility of vacuum forming raised numbers into the clock face, the potential of this market has been considerably increased.

Another unusual combination of metallized butyrate sheet and vacuum forming is in the fabrication of inexpensive, decorative picture frames that are formed to shape and cemented onto a heavy Masonite backing.

Industrial Uses

Among the many end-use applications for the metallized sheet, those in the industrial field are still in their infancy. It is generally agreed, however, that in a few years, industrial applications will probably be the largest volume market.

One supplier of an aluminized styrene sheet, for example, reports that the material was used in the 1952 and 1953 Frigidaire line and is currently being used in the freezer doors of Norge, Servel, Gibson, and Philco. The metallized sheet also appeared in the 1954 Westinghouse radio line.

The applications which will make use of the metallized plastics sheets in 1955, however, are the big question mark. Nobody will do any talking about it, but everybody leaves you with the impression that it will be big—really big—especially as it applies to the refrigeration and automotive industries.

For refrigerator applications, principally trim or decorative parts for various doors and trays, metallized styrene is the most important material—by virtue of the fact that it has excellent dimensional stability, is strong, and will not absorb moisture.

For automotive applications, it is

conceded that by 1955 metallized Mylar polyester film will be the big name in the field. According to several manufacturers, the 1955 line of practically every brand-name car will carry sheets of metallized Mylar laminated to fabric as an upholstery material for kick panels, dash boards, bolsters, arm rests, etc. Edging for seat upholstery is also a possibility.

Another important industrial market for metallized sheet is the radio field. Many prominent manufacturers are replacing their metal grilles with perforated sheets of gold-metallized styrene. In the home appliance field, decorative strips, name plates, identification, and instruction panels fabricated of metallized materials are gradually becoming standard equipment.

The highly reflective, mirror-like surface of the material is also being put to good use in the design of vending machines. One juke box manufacturer, for example, has replaced a sheet of highly polished metal which formerly lined the interior of his machines with a sheet of metallized acetate.

As indicated in the discussion of automotive applications, all those who have seen Du Pont's Mylar polyester film in action are making big predictions. Mylar's tensile strength is exceedingly high, it has excellent tear resistance, and its impact strength is at least twice that of any known commercial film.

Because of the tensile strength of the material, gages as thin as 0.00025 in. can be laminated to leather, fabric, paper, thin steel, or plastics materials and it is a simple matter to emboss a sheet of metallized Mylar in any pattern or texture.

When metallized Mylar is used in thin gages, it will take on the characteristics of the material to which it is laminated without having to be embossed. Several shoe manufacturers have taken advantage of this property to fabricate an attractive lady's shoe from a sheet of metallized Mylar laminated to leather. This same type of lamination can also be used for other garment accessories, such as belts or handbags.

Perhaps the biggest outlet for the material in the garment field, however, will be metallic yarn. The metallized sheet can be cut into strips, spun, and converted into a strong, yarn that can be dry cleaned.

Work has even been done on the possibility of laminating metallized Mylar to a sheet of butyrate and then vacuum forming the combination. Pieces formed from this lamination would be suitable for applications that would require outstanding weathering resistance.

Expansion

Just what actual volume of plastics sheet is being or will be metallized to meet these demands, no one in the tight-lipped, highly competitive industry is prepared to say. One thing for sure—it is not a market to be discounted.

In one typical application alone (the Marxman Skyroplane described above), more than *one million* units have already been sold and the end is still nowhere in sight. Keeping in mind projected plans for 1955, the three leaders in the sales of metallized plastics sheets agree that this one million sales figure will look like peanuts once the refrigerator, automotive, home appliance, and textile manufacturers take the wraps off the new applications they have devised to take advantage of metallized materials.—END

Radiation Effects

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radiation energy either directly or through an energy transfer mechanism from other molecular groups, and then to damp out the absorbed energy through its resonant structure. This is a very important phenomenon and should be studied more extensively.

Free radical spectrum—Schneider and his associates observed sharp paramagnetic resonances in many irradiated plastics. The spectrum reveals a fine structure that is believed to rise from the interaction of unpaired electrons with protons. The observation of free radicals in high polymers is thus established directly.

Secondary Changes

Appearance, color, and transparency—In general, high polymers become brownish in color when irradiated by high doses of radiation. At 0.2 C units, for example, polyethylene becomes light yellow. Upon further irradiation, it changes to yellow, brown, and dark amber. The original wax-like translucency is changed to transparency. For polyvinyl chloride, a greenish color develops after 1 or 2 mega rep irradiation. The optical density increases with the radiation. At 100 mega rep, it is dark and non-transparent. For smaller doses, such as 30 mega rep, the color changes from greenish to dark brownish, and the polymer finally becomes non-transparent on standing. Polyethylene loses the wax-like appearance and becomes transparent also on melting. Since the effect of radiation is to change the structure from crystalline to amorphous, one would expect more transparency on irradiation. It was found that the temperature at which polyethylene becomes transparent is lowered about 6° C. for 8 C units of pile irradiation. Highly irradiated samples have the appearance and transparency of a dark-tinted glass at room temperature. The sample becomes brittle. Other high polymers, such as Teflon, crumble to powder-like material. Lucite develops cracks and a brownish-pink color.

Melting—For radiation up to about 0.05 to 0.1 C units, polyethylene still melts at about 115° C.; above 0.1 C units, it no longer melts, even at temperatures of 300° C., but loses its crystalline character at about 110° C. Above this temperature a rubber-like elasticity is developed. The sudden change that occurs corresponds to about one cross-link per molecule. This sudden increase in infusibility with a small increase in dose after a certain dosage was even more noticeable in paraffin. Charlesby found that the product of radiation dose, chain length, and density of normal hydrocarbons is constant at this sharp infusibility point.

Ultra-violet fluorescence—Under ultra-violet light, non-irradiated polyethylene gives a purple fluorescence. Irradiation changes this to a much more intense blue-white to yellow-white. The fluorescence is closely bound up with the crystalline phase of the polyethylene, since the fluorescence becomes very much weaker in the amorphous state above 110° C. No experiment has been carried out for pure amorphous polyethylene at room temperature.

Solubility—At 80° C., polyethylene is soluble in a number of organic solvents. After irradiation for 0.1 C units, however, only a portion becomes soluble in common solvents, while the remainder is completely insoluble, and retains its original shape with swelling to about 150% of the initial size. Longer irradiation produces less swelling.

Molecular weight—Charlesby and also Lawton, Bueche, and Balwit found that paraffin can be converted into an insoluble rubber-like material by about 800 mega rep. The latter authors found that the amount of irradiation necessary to cause insolubility is inversely proportional to the molecular weight to the 1.26 power. In the case of siloxanes, Charlesby found that in the molecular weight range of 10^5 to 2×10^6, the molecular weight is inversely proportional to the radiation dose. Charlesby was also able to determine the molecular weight of polystyrene through an irradiation technique.

Resistance to mineral acids—In boiling sulfuric acid, ordinary polyethylene carbonizes, while irradiated polyethylene is attacked only on the surface. In aqua regia at 100° C., the attack on ordinary

polyethylene is also much stronger than that on the irradiated sample.

Cooling curve—Because of the crystalline structure, polyethylene exhibits a cooling curve typical of a solid by having a well-defined melting point. As it is irradiated, the shape of the cooling curve changes, as observed by Charlesby and Ross, until finally no transition temperature is noted. The structure becomes typical of a liquid.

Density or specific volume—The specific volume of polyethylene as a function of temperature for various degrees of irradiation has been studied by Charlesby. For slightly irradiated polyethylene, the volume expands with increase of temperature. Below about 110° C., the expansion curve is composed of that for the crystalline and amorphous states, and above 110° C. the expansion curve is due to the amorphous phase only. For a given temperature, e.g., 150° C., the specific volume is found to vary inversely with the degree of cross-linking, and at this temperature varies from 1.28 to 1.12 $cm.^3/g.$ for polyethylene of 0 to about 36% cross-linking by irradiation.

Coefficient of expansion—The slope of the specific volume-temperature curve equals three times the coefficient of expansion. In the temperature range 120 to 140° C., where the cross-linked polyethylene exists in amorphous form, the coefficient of expansion varies inversely with increasing degree of cross-linking which varies directly with the irradiation dose. The coefficient of expansion drops from $0.90 \times 10^{-3}/°$ C. for 0% cross-linked polyethylene to $0.55 \times 10^{-3}/°$ C. for 37% cross-linked material.

Equation of state—For amorphous polyethylene, Charlesby has obtained an equation of state similar to that for a gas whose molecules are of finite size and attract one another.

Temperature of deformation—Charlesby found that the temperature of deformation, based on the A.S.T.M. specification, rose only slightly for the irradiated polyethylene, whereas considerable changes in mechanical properties were observed. The study of temperature of deformation, therefore, could be misleading.

Young's modulus—This property was measured by Charlesby using

static and dynamic methods. The modulus decreases as temperature increases for non-irradiated or slightly irradiated polyethylene and drops to insignificantly small values at about 115° C., as one would expect. For samples of higher irradiation doses, the Young's modulus maintains a certain value even at temperatures higher than the usual melting point. For doses above 40 C units, the Young's modulus at all temperatures up to 200° C. is higher than that for non-irradiated samples at room temperature. This illustrates clearly the cross-linking effect from radiation. High energy radiation not only creates cross-links but also destroys crystallinity. The former process increases Young's modulus while the latter causes it to drop.

Hardness—While the Rockwell hardness of some plastics decreases with irradiation dosage, that for polyethylene increases at room temperature. According to work carried out by the Materials Engineering Dept. of Westinghouse Electric Corp., the behavior of hardness at high temperatures for irradiated polyethylene is similar to that of Young's modulus. The irradiated samples maintain a certain hardness way above the normal melting point of polyethylene.

Other mechanical properties—At room temperature, the variation of tensile strength of polyethylene with radiation dose up to 10^4 mega rep is less than 15 percent. The elongation, however, drops to 10 to 50% of its initial value after about 100 mega rep. Further irradiation decreases the elongation still more. The shear strength remains almost constant up to about 5000 mega rep, where the value suddenly increases several hundred percent of its original value. The impact strength begins to decrease to half of its original value at 500 mega rep. At 3000 mega rep, the impact strength is practically nil. Relatively small amounts of radiation reduce creep to a considerable extent and recovery after deformation tends to be more elastic in character.

Electrical properties—For a high degree of cross-linking in polyethylene, the power factor is increased very appreciably for low and medium frequencies at room temperature. At higher frequencies, the power factor is about the same as

that for ordinary polyethylene. Charlesby attributed the deterioration in the power factor to the presence of double bonds. The volume resistivity of polyethylene increases only 50% after 9×10^9 mega rep. For the same dose, the increase in dielectric strength is about 25 percent.

Applications of Radiation

The application of basic scientific discovery and knowledge to practice is limited only by the inventive capacity of those who are interested. Radiation effects in high polymers is no exception. In looking toward practical applications of this new science, it must be remembered that, from an economic viewpoint, a new product or process is usually more expensive at the beginning. The interplay between technical and economic aspects is therefore very important in any new development. The industrial application of radiation and its effect on materials is in its infancy, and the present discussion on application only to illustrate the potentialities.

Because of today's relatively high cost of atomic radiation, any industrial application must have unique features before it can compete economically with conventional processes. The present applications are therefore limited. Since the atomic power program is being pushed vigorously forward, there is reason to believe that the radiation energy will be cheap enough to be used as an agent in more common processes.

Practical applications may be considered with regard to the beneficial effects of radiation on the one hand, and the deleterious effects on the other. Following are some applications which appear practical as of today:

Cross-linking of high polymers—The cross-linking of high polymers such as polyethylene introduces materials of improved and desirable properties thus far unobtainable by other means. The high resistance of the irradiated polymer to solvents, acids, and elevated temperatures would naturally widen its uses. Irradiated polyethylene for pharmaceutical containers and electrical insulation has been made available commercially by electron bombardment. Large polyethylene pipe fittings are irradiated for improved mechanical performance. The present cost is not accurately known, but is estimated to be of the order of 10 to 30¢/lb. for thin pieces.

Gas formation in plastics—As mentioned earlier, hydrochloric acid is formed when polyvinyl chloride is irradiated. Henley and Miller have added to the plastic some acid-sensitive dye which changes color when hydrochloric acid is released. A dosimeter for measuring radiation dosage results. An application of gas formation in polymethyl methacrylate has been demonstrated by Ross and Charlesby. The volume of irradiated Lucite will expand eight-fold upon heating. Thus a foamed plastic is obtained.

Vulcanization and polymerization—Atomic radiation offers a promising future in the field of vulcanization and polymerization. Manowitz, in his interesting review of the subject, anticipates large-scale polymerization by radiation in competition with chemical methods in the future. The following are the unique features associated with this application of radiation:

1) No foreign and sometimes undesirable catalytic materials are introduced. Since radiation provides free radicals without a catalyst, it is uniquely advantageous. A typical example is N-vinyl pyrollidone polymer used in blood plasma. Chemical polymerization requires the introduction of ammonium hydroxide and hydrogen peroxide, which are not desirable. Attempts have been made at the Brookhaven National Laboratory to polymerize it with radiation.

2) In certain materials, polymerization is otherwise impossible. Manowitz has pointed out that poly-perfluoro-propylene, -butadiene, and -acrylonitrile have been polymerized only by means of atomic radiation.

3) Delayed polymerization is possible by first irradiating the monomer at a low temperature and then by warming it at any desired later moment for polymerization.

4) Polymerization *in situ* can be achieved. Where high polymers are used in certain intricate gear, polymerization *in situ* may make possible new and advantageous methods of fabrication.

5) Polymerization can be realized at lower temperatures. Not only can heat-sensitive monomers be thus polymerized, but also complicated

engineering processes can sometimes be simplified. As an example of the latter, polyethylene is usually polymerized from ethylene at high temperature and high pressure. It has since been demonstrated by workers at Yale and Michigan that polymerization can proceed at room temperature under pressure.

6) Polymerization in the solid state is possible. For example, Mesrobian et al. have polymerized acrylamide to completion with about 2.2 mega rep Co^{60}—γ irradiation.

7) Additional means of molecular weight control is provided. The molecular weight of a high polymer formed by thermal or catalytic means varies inversely with the temperature, while that formed by radiation varies directly with temperature. This suggests the possibility of obtaining high molecular polymers by temperature control.

Radiation dosimeter—We have previously mentioned one type of radiation dosimeter. Since polymerization is a chain reaction, which means that the yield of the reaction can be unusually high for each initial starting agent, the reaction may be used for detecting low level radiation. The turbidity caused by polymerization of acrylonitrile, under investigation by Berstein et al., may be developed into a practical dosimeter capable of detecting radiation as low as 10 roentgens.

Surface coatings and laminates—Loewe recalled an early experience wherein a water-repellent and strongly adherent surface layer was formed on glass upon bombardment with cathode rays. This layer appeared to be highly resistant to various kinds of chemical and mechanical treatment. A study of the phenomenon indicated that the stopcock grease which evaporated on the glass from the vacuum system was the cause. Apparently, a thin, strong layer of a high polymer was formed. Loewe made similar films from other materials and considered his finding a method for imparting weather and wear-resistant surfaces to many indoor and outdoor objects. Cole has recently published similar findings. Monk suggests irradiation as a means of laminating sheets of glass together with silicone compounds.

Deleterious effects—Water may float a boat, but it may also cause it

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to sink. In like manner, radiation affects high polymers. Rubber gaskets, O-rings and many plastic parts become brittle when irradiated to 1000 or more mega rep. At this dosage, electrical insulating oil may produce 10 to 15 times its own volume in gases. Degradation of polymers becomes a serious effect and studies will aim at minimizing damaging effects. For example, the phenyl and other aromatic ring groups are known to resist radiation. In designing plastics for intense radiation fields, this may be taken into account. Allen and his associates at the University of Pittsburgh have found empirically that O-rings made from rubber with iron oxide as filler can stand higher radiation than those without iron oxide filler. Many similar experiments may be carried out towards the design of better materials for radiation resistance.

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BIBLIOGRAPHY

(By F. A. Pecjak and K. H. Sun)

1. Alexander, P., Charlesby, A., and Ross, M., Degradation of Solid Polymethylmethacrylate by Ionizing Radiation, Proc. Roy. Soc. *223*, No. 1154, 392 (May 1954).
2. Alexander, P. and Fox, M., Polymerization and Depolymerization by X-Rays; Effects of Protective Agents, J. Chim. Phys. *50*, 415 (June 1953).
3. Allen, A. J., University of Pittsburgh, private communication.
4. Allen, A. O., Richardson, D. M., Effect of Clinton Reactor Radiation on Plastics, CNL-16 (1948).
5. Anon., Polymers by Radiation, Ind. Eng. Chem. *44*, 11A (May 1952).
6. Anon., Cross-linking of Polythene In the Atomic Pile, Brit. Plastics *26*, 79 (Mar. 1953).
7. Anon., A New Curing Process, Perfected by General Electric Co., Plastics News Letter *13*, No. 20, (May 1953).
8. Anon., "Atom-Cooked" Plastics, Atomics *4*, 142 (June 1953).
9. Anon., Polypropertied Polymers, Ind. Eng. Chem. *45*, 11A (Sept. 1953).
10. Anon., Crosslinked Polyethylene, Chem. and Eng. News *32*, 1392 (Apr. 1954).
11. Anon., Irradiated Insulation, Electronic Design *2*, 6 (Apr. 1954).
12. Anon., Irradiated Polyethylene, Modern Plastics *31*, 100 (Apr. 1954).
13. Anon., Effect of Ionizing Radiation on High Polymers, European Scientific Notes, No. 8-7, 90 (Apr. 1954).
14. Ballantine, D. S., Colombo, P., Glines, A., and Manowitz, B., Gamma Ray Initiated Polymerization of Styrene and Methyl Methacrylate, International Congress on Nuclear Engineering 61 (June 20-25, 1954).
15. Ballantine, D. S., Dienes, G. J., Manowitz, B., Ander, P., and Mesrobian, B., Evaluation of Polyethylene Cross-Linked by Ionizing Radiation, J. Polymer Sci. *8*, 410 (Apr. 1954).
16. Ballantine, D., Manowitz, B., Polymerization of Vinyl Monomers by Intense Gamma Radiation; Progress Report on Fission Products Utilization, Part 5. Unclassified Section, BNL-229 (T-35) (Mar. 1953).
17. Berstein, I. A., Farmer, E. C., Rothschild, W. G., and Spalding, F. R., Studies on the Gamma-Radiation-Induced Polymerization of Acrylonitrile, J. Chem. Phys. *21*, 1303 (July 1953).
18. Bopp, C. D., and Sisman, O., Radiation Stability of Plastics and Elastomers, ORNL-1373, 97 p. (July 1953).
19. Breger, I. A., Transformation of Organic Substances by Alpha Particles and Deuterons, J. Phys. Colloid Chem. *52*, 551 (Mar. 1948).
20. Bretton, R. H., Hayward, J. C., Jr., and

Shair, K. A., Effect of Gamma Radiation on Chemical Reactions. I, Progress Report No. 1, NYO-3307, 10p. (Jan. 1952).
21 Ibid., Progress Report No. 2, NYO-3309, 12p. (Apr. 1952).
22 Ibid., Progress Report No. 3, NYO-3310, 14p. (July 1952).
23. Ibid., Progress Report No. 4, NYO-3311, 14p. (Oct. 1952).
24. Ibid., Progress Report No. 5, NYO-3312 12p. (June 1953).
25. Burr, J. G., and Garrison, W. M., Effect of Radiation on Physical Properties of Plastics, AECD-2078, (1948).
26. Burton, M., and Patrick, W. N., Radiation Chemistry of Mixtures, J. Phys. Chem. *58*, 421, 424 (May 1954).
27. Byrne, J., Costikyan, T. W., Hanford, C. B., Johnson, D. L., and Mann, W. L., Evolution of Halides from Halogenated Plastics Exposed to Gamma Radiation, Ind. Eng. Chem. *45*, 2549 (Nov. 1953).
28. Byrne, J., and Mann, W. L., Evolution of Halides from Halogenated Plastics Exposed to Gamma Radiation, N.S.A. *7*, No. 3, #994, (Feb. 15, 1953).
29. Chapiro, A., Polymerization with the Aid of Gamma-Rays, Compt. rend. *228*, (May '48).
30. Chapiro, A., Polymerization by Gamma-Rays, Compt. rend., *229*, 827 (Oct. 1949).
31. Chapiro, A., On the Polymerization of Vinylic Compds. Initiated by T Rays I., J. Chim. Phys. *47*, 747 (Sept.-Oct. 1950).
32. Ibid., II, J. Chim. Phys. *47*, (Sept.-Oct. '50). 1950).
33. Chapiro, A., Cousin, C. H., Landler, I., and Magat, M., Polymerization Initiated by Nuclear Radiation, Rec. trav. chim. *68*, 1037 (1949).
34. Chapiro, A., et. al., Study of Polymerization Initiated by Nuclear Radiation, Rec. trav. chim., *68*, 1037 (1949); Science, *113*, 718 (1951).
35. Charlesby, A., Decomposition and Polymerization of Polytetrafluorethylene by Pile Radiation, AERE-M/R-978, 10p. (July 1952).
36. Charlesby, A., Cross-linking of Polythene by Pile Radiation, Proc. Roy. Soc. *215*, (Nov. '52).
37. Charlesby, A., Effect of High-Energy Radiation on Long-Chain Polymers, Nature *171*, 167 (Jan. 1953).
38. Charlesby, A., Investigation of Halo Patterns of Amorphous Polymers, J. Polymer Sci. *10*, 201 (Feb. 1953).
39. Charlseby, A., Effect of High Energy Radiation on the Solubility and Molecular Weight Distribution of Rubber, AERE-M/R-1185 (Apr. 1953).
40. Charlesby, A., Effect of High Energy Radiation on Some Long-chain Polymers, Plastics (London) *18*, 142-5 (May 1953).
41. Charlesby, A., Comparison of Equations of State for Amorphous Long-chain Polymers, Phil. Mag. *44*, 578 (June 1953).
42. Charlesby, A., Solubility and Molecular Size Distribution of Cross-linked Polystyrene, J. Polymer Sci. *11*, 513 (Dec. 1953).
43. Charlesby, A., Swelling Properties of Polystyrene Crosslinked by High Energy Radiation, J. Polymer Sci. *11*, 521 (Dec. 1953).
44. Charlesby, A., Crosslinking of Rubber by Pile Radiation, Atomics *5*, 12 (Jan. 1954).
45. Charlesby, A., Crosslinking and Degradation of Paraffin Chains by High-Energy Radiation, Proc. Roy. Soc. *222*, 60 (Feb. 1954).
46. Charlesby, A., Effect of High-Energy Radiation on Polymers, Bull. Am. Phys. Soc. *29*, No. 3, 14 (Mar. 1954).
47. Charlesby, A., How Radiation Affects Long-chain Polymers, Nucleonics *12*, 18 (June 1954).
48. Charlesby, A., and Hancock, N. H., Effect of Crosslinking on the Elastic Modulus of Polythene, Proc. Roy. Soc. *218*, 245 (June 1953).
49. Charlesby, A., Lawton, E. J., and Sisman, O., Modification of Polymers by Irradiation, Gordon Research Conference on Radiation Chemistry (July 6, 1954).
50. Charlesby, A., and Ross, M., The Effect of Pile Radiation on the Density and Melting of Polythene, AERE-M/R-1003, 21p. (Aug. 1952).
51. Charlesby, A., and Ross, M., Effect of Crosslinking on the Density and Melting of Polythene, Proc. Roy. Soc. *217*, 122 (Mar. 1953).
52. Charlesby, A., and Ross, M., Breakdown of Methyl Methacrylate Polymer by High-Energy Radiation, Nature *171*, 1153 (June 1953).
53. Charlesby, A., Ross, M., and Alexander, P., Degradation of Solid Polymethyl Methacrylate by Ionizing Radiation, A.E.R.E. M/R 1269 (Oct. 1953).
54. Cole, O. P., Effect of Irradiation on Polyethylene Coatings, Gordon Research Conference on Organic Coatings (July 15, 1954).
55. Coleman, J .H., and Bohm, D., A Method for Increasing the Electrical Resistivity of Insulators under Ionizing Radiaton, J. Appl. Phys. *24*, 497 (Apr. 1953).
56. Collinson, E., and Dainton, F. S., X-Ray and Gamma Ray Induced Polymerization of Aqueous Solutions of Acrylonitrile. A General Discussion of the Faraday Society, (Aberdeen University Press Ltd., No. 12, p. 212, (1952).
57. Dainton, F. S., Effect of Gamma and X-Rays on Dilute Aqueous Solutions of Acrylonitrile, Nature *160*, 268, (1947).
58. Dainton, F. S., On Existence of Free Atoms and Radicals in Water and Aqueous Solutions to Ionizing Radiation, J. Phys. Chem. *52*, 490 (1948).
59. Dainton, F. S., Polymerization as a Guide to Tract Distribution, J. Chim. Phys. *48*, 182 (Mar., Apr. 1951).
60. Davidson, W. L., and Geib, I. G., Effects of Pile Bombardment on Uncured Elastomers, J. Appl. Phys. *19*, 427 (May 1948).
61. Davidson, W. L., and Geib, I. G., Effect of Pile Bombardment on Uncured Elastomers, Rubber Chem. and Technol. *22*, 138 (Jan. 1949).
62. Day, M. J., and Stein, G., Effects of X-Rays upon Plastics; Electronic Processes, Nature *168*, 644 (Oct. 1951).
63. Dienes, G. J., Radiation Effects in Solids, Ann. Rev. of Nuc. Sci. *2*, 187 (1953).
64. Dole, M., Effect of Radiation on Colloidal and High Polymeric Substances, Symposium IV. Chemistry and Physics of Radiation Dosimetry, Report. Pt. 1 Unclassified Papers (105925), p120, (Sept. 1950); Army Chemical Center, Maryland.
65. Dole, M., Keeling, C. D., and Rose, D. G., How Poyethylene Crosslinks, Chem. Eng. News *32*, 1342 (Apr. 1954).
66. Eidus, T., and Puzitskii, K. V., Polymerization and Other Transformations of Ethylene and Propylene under the Influence of Heat, Free Radicals, and other Active Particles, Uspekhi Kim *22*, 838, (1953); C. A. *47*, 11800 (Nov. 1953).
67. Faraday Society, No. 12, Radiation Chemistry, Discussions of the Faraday Society, (Aberdeen University Press Ltd., Aberdeen, 1952).
68. Farmer, F. T., Electrical Properties of Polystyrene, Nature 150, 521 (1942).
69. Fields, M., Chemical Systems Sensitive to Radiation, N.S.A. *8*, No. 1, #401, (Jan. 1954).
70. Fowler, J. F., and Farmer, F. T., Conductivity Induced in Insulating Materials by X-rays, Nature *173*, 317, (Feb. 1954).
71. Fox, M., Action of Certain Protective Compounds on γ-Ray Damage to Polymeric Solutions, Compt. rend. *237*, 1682 (Dec. 1953).
72. Gold, L., Distribution of Radioactivity in Labeled Polymers, Nucleonics *11*, No. 7, 48 (July 1953).
73. Hayward, J. C., Jr., and Bretton, R. H., Kinetics of the Ethylene Reaction Initiated by Gamma Radiation, Program of International Congress on Nuclear Engineering, *62* (June 20-25, 1954).
74. Henley, E. J., and Miller, A., Gamma-Ray Dosimetry with Polyvinyl-Chloride Films, Nucleonics *9*, No. 6, (Dec. 1951).
75. Hobbs, L. M., Pletcher, D .W., and Brown, D. E., Effects of Gamma Radiation on Rubber and on Polymerization, COO-196 Progress Report 5, 158 (Sept. 1953).
76. Kline, G. M., The Year 1953 in Review, Modern Plastics, *31*, 117 (Jan. 1954).
77. Kratky, O., and Porod, G., X-Ray Investigation of Dissolved Chain Molecules, Rec. Trav. Chim. *68*, 1106 (1949).
78. Landler, I., and Magat, M., On the Polymerization of Styrene Induced by Slow Neutrons, Comp. rend. *226*, 1720 (1948).
79. Landler, I., and Magat, M., Preliminary Results of Styrene Polymerization Initiated by Slow Neutrons, Bull. Soc. Chim. Belges, *57*, 381 (1948).
80. Lawton, E. J., Balwit, J. S., and Bueche, A. M., Effect of Initial Molecular Weight on Some Properties of Irradiated Polyethylene, Abstracts, 125th meeting of the Am. Chem. Soc., 7R (Mar. 24-Apr. 1, 1954).
81. Lawton, E. J., Bellamy, W. D., Hungate, R. E., Bryant, M. P., and Hall, E., Some Effects of High Velocity Electrons on Wood, Science *113*, 380 (1951).
82. Lawton, E. J., Bueche, A .M., and Balwit, J. S. Irradiation of Polymers by High-Energy Electrons, Nature *172*, 76 (July 1953).
83. Lewis, J. G., Martin, J. J., and Anderson, L. C., Polymerization of Ethylene by Gamma Radiation, Program of International Congress on Nuclear Engineering, 62 (June 20-25, 1954).
84. Lind, S. C., "The Chemical Effects of Alpha Particles and Electrons," (Chemical Catalog Company, Inc., New York, 1928), second edition.
85. Lindsey, M. H., Brown, D. E., and Pletcher,, D. W., Effects of Co^{60} Gamma Radiation on Formation and Degradation of Polymers, Bull. Am. Phys. Soc. *29*, No. 3, 14 (March 1954).
86. Little, K., Irradiation of Linear High Polymers, Nature *170*, 1075 (Dec. 1952).
87. Loewe, S., Polymerization by Means of High-Energy Electrons, Science *114*, 555 (Nov. 1951).
88. Magee, J. L., Radiation Chemistry, Ann. Rev. of Nuc. Sci. *3*, 171 (1953).
89. Manion, J. P., and Burton, M., Radiolysis of Hydrocarbon Mixtures, J. Phys. Chem. *56*, 560 (May 1952).
90. Mannal, C., Testing Electrical Insulation for Use in T-Ray Fields, Nucleonics *12*, 49 (June 1954).
91. Manowitz, B., Industrial Future of Radiation Chemistry, Nucleonics *11*, 18 (Oct. 1953).
92. Manowitz, B., Nuclear Reactors, Fission Products and Their Possibilities and Limitations for the Industrial Future of Radiation Chemistry, BNL-1519 (July 1953).
93. Manowitz, B., Horrigan, R. V., and Bretton, R. H., Progress Report on Fission Products Utilization; I. Preliminary Studies on Industrial Applications of Intense Gamma Radiation, BNL-141, 15 p., (Dec. 1950).
94. Manowitz, B., Horrigan, R. V., and Bretton, R. H., Preliminary Studies on Industrial Applications of Intense Gamma Radiation, BNL-141 (T-27) (Dec. 1951).
95. Martin, J. J., et. al., Effect of Radiation on Chemical Reactions (Including polymerization), COO-196 Progress Report *5*, 21 (Sept. 1953).
96. Martin, J. J., et. al., Effect of Radiation

on Chemical Reactions (B. Polymerization of Ethylene by Means of Gamma Radiation), COO-198, Progress Report 6, 12 (April 1954).

97. Mayburg, S., and Lawrence, W. L., Conductivity Change in Polyethylene During γ-Irradiation, J. Appl. Phys. *23*, 1006 (Sept. 1952).

98. McClinton, A. T., Brancato, E. L., Phillips, R. S., and Rabin, H., Radiation Effects on Dielectrics, NRL Memorandum Report 146, Progress Report No. 1 (Apr. 1953).

99. McClinton, A. T., Brancato, E. L., Rabin, H., Phillips, R. S., and Vail, C. R., Radiation Effects on Dielectrics, NRL Memorandum Report 218, Progress Report No. 2, 1 (Oct. 1953).

100. Mesrobian, R. B., and Ander, P., Gamma-Ray Polymerization of Acrylamide in the Solid State, Bulletin, American Phys. Soc. *29*, 15 (Mar. 1954).

101. Mesrobian, R. B., Ander, P., Ballantine, D. S., and Dienes, G. J., Gamma-Ray Polymerization of Acrylamide in the Solid State, J. Chem. Phys. *22*, 565 (Mar. 1954).

102. Monk, G. S., Coloration of Optical Materials by High-Energy Radiations, ANL-4536 (July 1950).

103. Mund, W., Radio Chemical Polymerization of Vinyl Chloride at Constant Pressure, Bull. Soc. Chim Belges *62*, 109 (1953).

104. Mund, W., Herman, J. A., and Verfaillie, G., Polymerization of Vinyl Chloride under the Action of Rays, Bull. Classe Sci. Acad. Roy. Belg. *35*, 656 (1949).

105. Myron, G. B., and Linschitz, H., Non-Electronic Dose Rate Indicating Systems, NP-4400: Quarterly Progress Report 2.

106. Nozaki, K., Irradiation Catalyzed Polymerization of Vinyl Compounds, C. A. *48*, 4882 (Apr. 1954).

107. Patrick, W. N., and Burton, M., Polymer Production in Radiolysis of Benzene, J. Am. Chem. Soc. *76*, 2626, (May 1954).

108. Prevot, A., Determination of X-Ray Dosage by Polymerization Reactions, Compt. rend. *230*, 288 (Jan. 1950).

109. Rexer, E., Accelerated Poylmerization with Gamma- and Roentgen Quanta. Reichsber. Physik (Beihefte Physik Z.) *1*, 111 (1944).

110. Rosenblum, C., Benzene Formation in the Radiochemical Polymerization of Acetylene, J. Phys. Colloid Chem. *52*, 474 (Mar. 1948).

111. Ross, M., and Charlesby, A., Effect of Pile Radiation on Methyl Methacrylate, AERE-M/R-1067 20p. (Jan. 1953).

112. Ross, M., and Charlesby, A., Effect of Pile Radiation on Polymethyl Methacrylate ("PERSPEX")-I, Atomics *4*, 189 (Aug. 1953).

113. Ryan, J. W., Effects of Radiation on Organic Materials, GEL-57; DF52GL242, 32p. (Dec. 1952).

114. Ryan, J. W., Effect of Gamma Radiation on Certain Rubbers and Plastics, Nucleonics *11*, 13 (Aug. 1953).

115. Ryan, J. W., Radiation of Polytetrafluoroethylene, Modern Plastics, *31*, 152, (Oct. 1953).

116. Ryan, J. W., Effect of Pile Radiation on Electrical Insulation, Modern Plastics *31*, 148 (Apr. 1954).

117. Sachs, F., Effect of α-β-γ and X-Rays on Organic Compounds; A Literature Search, Y-904, 92p. (Aug. 1952).

118. Saeman, J. F., Millett, M. A., and Lawton, E. J., Effect of High-Energy Cathode Rays on Cellulose, Ind. Eng. Chem. *44*, 2848 (December 1952).

119. Seitz, F., On the Disordering of Solids by Action of Fast Massive Particles, A General Discusson of the Faraday Society, (Gurney and Jackson, London, 1949), "Crystal Growth," No. 5, p. 271.

120. Seitz, F., Radiation Effects in Solids, Physics Today *5*, 6 (June 1952).

121. Seitzer, W. H., Goeckermann, R. H., and Tobolsky, A. V., B-Ray Initiation of Polymerization of Styrene and Methyl Methacrylate, J. Am. Chem. Soc. *75*, 755 (Feb. 1953).

122. Schmitz, J. V., and Lawton, E. J., Initiation of Vinyl Polymerization by Means of High-Energy Electrons, Science *113*, 718 (June 1951).

123. Schneider, E. E., Day, M. J., and Stein, G., Effects of X-Rays upon Plastics: Paramagnetic Resonance, Nature *168*, 645 (Oct. 1951).

124. Sheppard, H. R., and Gainer, G. C., Westinghouse Electric Corporation, private communication.

125. Sisman, O., and Bopp, C. D., Physical Properties of Irradiated Plastics, ORNL-928 226p. (June 1951).

126. Slater, J. C., Effects of Radiation on Materials, J. Appl. Phys. *22*, 237 (Mar. 1951).

127. Steigman, J., Arond, L. H., and Copperman, A., Some Chromophoretagged Polymers and Their Radiation Chemistry, A.C.S. Meeting Polymer Division, Chicago, 1953.

128. Tokuyasu, K., On Damage to Specimens by Shadowing Bombardment. I. Experiment, J. Appl. Phys. *24*, 953 (July 1953).

129. Wall, L. A., and Magat, M., Degradation of Polymers by γ-Rays and Neutrons, J. Chim. Phys. *50*, 308 (May 1953).

130. Wall, L. A., and Magat, M., Effects of Atomic Radiation on Polymers, Modern Plastics *30*, 111 (July 1953).

131. Warner, A. J., Muller, F A.., and Nordlin, H. G., Electrical Conductivity Induced by Ionizing Radiation in Some Polymeric Materials, J. Appl. Phys. *25*, 130 (Jan. 1954).

132. Watson, J. H. L., Vanpee, M., and Lind, S. C., Solids Condensed from Carbon Monoxide by Alpha Particles, J. Phys. Chem. *54*, 391 (Mar. 1950).—END

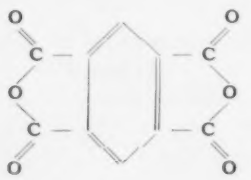
Epoxy Alloys

(*From page* 161)

tested. Epoxy resins could contribute flexibility and adhesion to melamine laminates, and melamine hardness and heat stability.

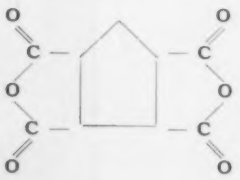
There appears to be very little work reported today on the possibilities of using epoxy systems catalyzed with acid anhydrides to produce alloys. The compatibility of acid catalyzed systems is much greater than the amine catalyzed ones, and many interesting possibilities can be investigated. One that deserves further investigation is a copolymer of a maleic anhydride-epoxy resin and an acrylonitrile polymer. Acrylonitrile polymers are soluble in organic anhydrides such as maleic (U.S. Patent 2,607,751), and maleic anhydride reacts with epoxies to form a good resin. An interesting alloy should result from this reaction.

Recently polybasic acid anhydrides have begun to appear, for instance, pyromelletic anhydride. The acid anhydride has been mentioned in early patents as a catalyst for epoxy resins, but the acid has only recently become available. This acid has the formula:



The possibilities of reacting this acid partially to form a polyester and then tieing it into an epoxy resin through the remaining carboxyl groups are at once apparent.

Another acid of similar type can be made by the oxidation of Nadic anhydride[6]. This acid can be oxidized readily to the following:



The possibility of the reactions

[6]Trademark of National Aniline Co. for endocis biyclo 2,2,1-heptene-2,3-carboxylic anhydride.

should be apparent at once on inspection of the formula.

The many theoretical possibilities of alloying with epoxies present unique difficulty to the product development manager. The epoxy resin producer has simplified his work somewhat by restricting the availability of epoxy resins to just a few, based upon bis-phenol A, glycerol, or resorcinol. It would be unwise for the research planner to dismiss the thought of other possibilities just for this reason, however, for many interesting ones can be postulated, and epoxy resin producers would be glad to make them if the market is attractive. In general, the planner will have to consider the probable cost of the epoxy resin based on a rough calculation of the raw material cost and a few trials in the laboratory in glass equipment to give an idea of yields and production difficulties. At this point, the epoxy resin manufacturer should be consulted because epoxy resins that appear easily made in glass sometimes turn out to be impossible in full scale equipment and some disappointments have already been experienced.

Factors in Choice of Resin

When choosing the resin to alloy with epoxies, consideration must be given to the compatibility of the epoxy resin and the desired end result. The relative cost of the resin is important, for great disparity is sometimes undesirable. If asphalt, for example, is alloyed with epoxies, then the effect of the epoxy on the asphalt must be noticeable in very small quantities for asphalt resins cannot bear much increase in price. If, on the other hand, the epoxy is to be cheapened by the addition of asphalt, the effect of large additions must not be very noticeable, for epoxies are relatively expensive and cannot bear reduction in quality.

In alloying with other resinous materials, the epoxy will generally be used to provide dimensional stability, adhesion to glass fibers or other materials embedded in the resin, or thermal stability (but not mechanical strength at high temperatures). The chemical resistance is also sometimes of interest as the epoxy can contribute outstanding resistance to alkaline environment.

The field of alloying with epoxies is very broad, and the temptation of

all on first becoming acquainted with these resins is to mix them indiscriminately with the hope that the epoxy will somehow do something to the other resin to improve it. This "shot-gun" type of research is not likely to be profitable and is not to be encouraged. The combinations that are possible are so great that chances of success are about as low as in a sweepstake. The alloy chemist must know what he wants, he must know his resins, and he must know his economics. If he knows all three, he will be successful in making some of the new alloys of epoxy resins that are sure to be developed and commercially introduced in the next few years.

U. S. PATENTS ON EPOXIES

Unmodified Epoxy Resins

Basic Epoxy Resins:

1,845,198—ethylene oxide—abietic acid resin
1,923,499—ethylene oxide polyhydroxy alcohol resin
2,054,099—epoxide polymerization process
2,121,695—epoxide polymerization process
2,149,498—epoxide polymerization process
2,187,006—epoxide polymerization process
2,324,483—epoxide resin cross linked with an acid anhydride
2,444,333—epoxide resin cross linked with an amine
2,450,234—allyl polyether of a poly glycol
2,464,753—allyl glycidyl ether of a bis-phenol
2,467,171—epoxy resin—epichlorohydrin-bis-phenol type
2,500,016—epoxy cyclohexanol hydroxy ether
2,500,449—epoxy resin
2,503,726—polymeric polyhydric alcohol
2,506,486—epoxy resin cross linked with a phenolic diol
2,512,996—epoxide resin—aliphatic and aromatic
2,528,359—epoxide resin—epichlorohydrin bis-phenol type
2,528,360—epoxide resin—epichlorohydrin bis-phenol type
2,528,932—poly epoxy and mono epoxy resin
2,528,933—epoxy adhesive
2,538,072—epoxide resin—epichlorohydrin bis-phenol type
2,543,419—epoxy ether of cyclopentadiene and a glycol
2,558,949—epichlorohydrin bis-phenol resin
2,582,945—epichlorohydrin bis-phenol resin
2,591,939—epichlorohydrin bis-phenol resin
2,592,560—epichlorohydrin bis-phenol resin
2,602,075—epichlorohydrin-phenolic hydroxy (hydroquinone) resin
2,615,007—epichlorohydrin bis-phenol resin
2,615,008—epichlorohydrin bis-phenol resin
2,623,023—polyepoxy derivative of cyplopentadiene and a glycol reacted with aconitic acid
2,637,715—epoxy resin cross linked with a carboxylic acid and dicyandiamide
2,642,412—epoxy resin cross linked with amines
2,665,266—epichlorohydrin-cardolite resin
2,668,805—epichlorohydrin bis-phenol resin
2,668,807—epichlorohydrin bis-phenol resin

Epoxy Esters:

1,845,198—ethylene oxide compound and resinous acid, e.g. abietic acid
1,922,409—ethylene oxide and polyhydroxy alcohol
2,123,718—ester of a urea-ethylene oxide resin and a carboxylic acid
2,125,594—ester of ethylene oxide and castor oil
2,197,813—epoxy alcohol and drying oil fatty acid
2,324,483—epoxy-dibasic carboxylic acid ester
2,456,408—epoxy drying oil ester
2,493,486—epoxy-tall oil ester
2,494,295—epoxy sulfonamide resin
2,500,765—epoxy-rosin-fatty acid ester
2,500,600—epoxy resin—oxalic acid
2,504,518—synthetic drying composition
2,541,027—epoxy resin—phosphoric acid
2,569,920—epoxy-carboxylic acid ester
2,575,440—epoxy-crotonic acid ester
2,596,737—epoxy-fatty acid and styrene
2,623,023—epoxy-carboxylic acid esters
2,653,141—partial esters of polyhydric phenols
2,667,463—epoxy-drying oil and cyclopentadiene

Epoxy Ethers:

2,553,718—glycidyl ethers
2,314,039—allyl glycidyl ether
2,500,016—epoxy ether derivatives of cyclohexanol

Epoxy-Ion Exchange Resins:

2,469,684—epoxy amine anion exchange resin
2,469,692—epoxy amine anion exchange resin
2,469,693—epoxy amine anion exchange resin
2,479,480—epoxy amine cation exchange resin
2,586,770—epoxy amine ion exchange resin
2,586,882—epoxy amine ion exchange resin

Chlorinated Epoxy Resins:

2,086,077—epichlorohydrin and chlorinated polyhydric alcohols
2,221,771—epoxy compound of 1-chloro-2-methyl propylene oxide 2,3
2,581,464—bis-phenol-epichlorohydrin resin containing chlorine
2,616,899—3,4-epoxy—1-butene and hexachlorocylcopentadiene

Epoxy Resin Alloys

Epoxy-Acrylic:

2,524,432—epoxy-acrylic acid resin

Epoxy-Alkyd:

2,591,539—epoxy and alkyd and aldehyde ammonia condensate

Epoxy-Amide:

2,510,886—epoxy and amides and polydydric phenols
2,589,245—epoxy and resinous amide (rosin amide) and carboxylic amides

Epoxy-Amine Resins:

2,510,885—epoxy resin and polyfunctional amine
2,511,913—epoxy resin and aromatic amine aldehyde condensate, e.g., aniline-formaldehyde resin
2,553,718—epoxy resin and amine
2,575,558—epoxy resin and amine
2,585,115—epoxy resin and polyamine
2,591,539—epoxy resin and aldehyde ammonia condensate and alkyd
2,637,716—epoxy resin and polyamine and polycarboxylic acid reaction product.

Epoxy-Melamine Resins:

2,381,121 2,458,796
2,413,755 2,528,359
2,414,289 2,528,360
2,637,715

Epoxy-Phenolic Resin:

2,502,145—epoxy-phenol oil resin
2,521,911—epoxy-phenolic resin
2,521,912—epoxy-phenolic resin
2,528,417—epoxy-phenolic pitch (petroleum tar) resin
2,542,664—epoxy-phenol oil resin

Epoxy-Polyester Resin:

2,504,518—epoxy and maleic acid mixed esters
2,626,223—epoxy and mixed polyesters

Epoxy-Styrene:

2,596,737—epoxy and styrene and polyester

Epoxy-Urea:

2,528,359
2,528,360
2,637,713

Epoxy-Vinyl:

2,160,943—vinyl chloride and propylene oxide ether
2,160,948—vinyl chloride and propylene oxide derivatives
2,434,179—vinyl acetate-epichlorohydrin resin
2,556,048—vinylidene chloride-aliphatic epoxides
2,555,500—4-vinyl cyclohexene and mono epoxide
2,559,177—vinyl and epoxy plasticizer
2,562,897—vinyl chloride and allyl glycidyl ether and allyl ester

Vinyl and Epoxy as a Stabilizer:

2,477,608 2,585,506
2,477,609 2,590,059
2,477,610 2,595,619
2,470,324 2,530,353
2,477,659 2,590,059

Epoxy-Isocyanate

2,574,979

Unclassified Patents

1,990,615 2,559,347
2,060,715 2,564,194
2,136,928 2,564,195
2,292,406 2,571,217
2,295,487 2,602,785
2,260,753 2,631,138
2,312,321 2,133,458
2,380,185 2,640,037
2,400,333 2,642,412
2,426,422 2,643,239
2,431,718 2,643,243
2,528,934 2,651,589
2,558,949 2,662,870
2,559,333 2,667,671

END

Are Your Fasteners HEADED FOR TROUBLE?

Screws are sometimes like people. If they "lose their heads" under pressure — if they turn out to be "softies" — if they don't "square up," they are *headed for trouble*. It takes only a few "bad" screws on the line each day to erase most planned assembly savings.

That is why quality standards for P-K Self-tapping Screws were set so *high* when they were first introduced by Parker-Kalon. Today, with even *higher standards* they continue to take top honors for dependability, despite many efforts to match them.

The difference between screws made to P-K standards and those that are "headed for trouble" are hard to see at a glance, but the effects of screw failure (parts spoilage, high reclamation costs) are quickly evident in mounting assembly costs.

P-K Self-tapping Screws are "headed for savings"—not only headed, but threaded, pointed, and heat-treated with the same purpose, to keep your assembly lines trouble-free. That's why so many more manufacturers of America's best known products specify P-K. For information on any fastening problem, talk to a P-K Assembly Engineer. Or write: Parker-Kalon Division, General American Transportation Corporation, 200 Varick St., New York 14.

P-K STANDARDS protect you against these and many other symptoms of Screws "headed for trouble". They don't "get by" P-K inspectors — that's why *all* P-K Self-tapping Screws can be "Guaranteed First Quality."

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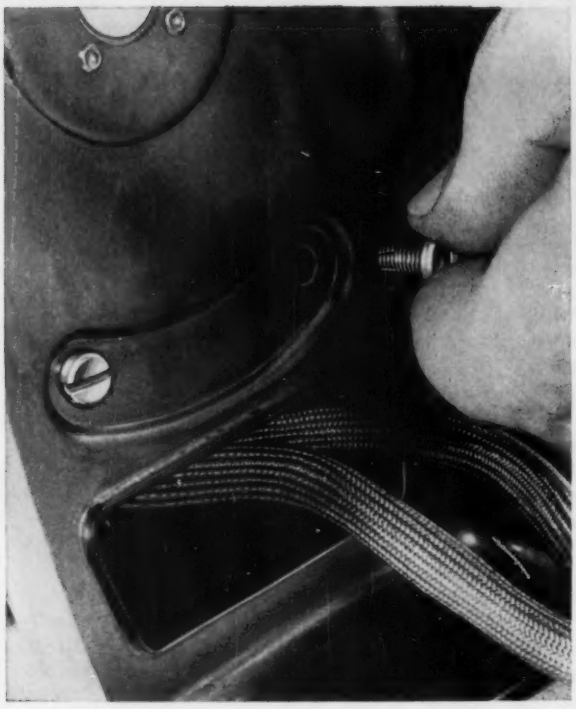

HOOVER SMOOTHED OUT trouble and speeded assembly of this Steam or Dry Iron by switching to P-K Self-tapping Screws for seven fastenings previously made with machine screws. Tapping and lock washers were eliminated. The assembly is made stronger than ever, with an important saving in time. Five P-K Type F Screws fasten the phenol formaldehyde handle to the sole plate cover (left). On the assembly line, these screws are power driven. One P-K Type-F Screw fastens the steam valve control support bracket to the die-cast aluminum filler tube at the front of the iron (not shown). One P-K Type A Screw fastens the heel closure plate to the terminal bracket (right).

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NEWS AND INTERPRETATIONS OF THE NEWS

By R. L. Van Boskirk

Carbide's Acrylic Esters

ANNOUNCEMENT that Carbide and Carbon Chemicals Co. has recently completed a new unit for commercial production of ethyl and methyl acrylates is of more than passing interest. There is nothing immediately sensational about it, for these materials have been available and used on a limited scale for some years, but it is possible that acrylic ester polymers may have considerable impact on various plastics material developments over the next 5 to 10 years.

Carbide and Carbon has been supplying acrylate monomers for a number of years and Rohm & Haas has been in the business for a long time. The monomers are used by many companies, but the acrylate monomer business is still a relatively small portion of the plastics industry.

Production capacity of the newly completed plant at Institute, W. Va., which has been several years a-building, is modest but utilitarian in that several varieties of acrylic acid esters may be produced therein. One that seems particularly useful is ethylhexyl acrylate, a monomer never before produced in large quantity. It imparts additional flexibility when used in resins as a comonomer with other monomers such as vinyl chloride. It makes gum more "chewy," makes coating films more "stretchy," makes vinyl chloride more flexible without use of plasticizer. The acrylate monomers are frequently used as a top dressing on vinyl film; and it is well known that an acrylate monomer copolymerized with vinyl chloride will produce a film of extreme clarity.

The paint companies have been licking their chops for a long time over the possibility of eventually obtaining a little less expensive acrylate copolymer, for it seems already well proved that acrylate emulsions in paint give a superior product.

Much Laboratory Work—Most of the above applications, except paint, are not yet talked about as products available in commercial quantities. However, there has been so much work done in the laboratory that it wouldn't be too surprising if a vinyl chloride-acrylate copolymer were to burst forth at any moment. Furthermore, these acrylic esters can be used as comonomers with styrene, vinyl acetate, vinylidene chloride, and methacrylates. The polymers are also used in textile and leather finishes, in production of transparent sheeting of excellent optical clarity, and in new molding and laminating resins. Outside the plastics industry, the acrylic esters have important uses as raw materials in synthetic fibers, pharmaceuticals, odorants, and lubricants.

It is hoped that fairly large-scale production of these acrylic esters and the assurance that they will always be available in good quantity will encourage more manufacturers to look into their possibilities. Outstanding properties, in addition to "built-in" flexibility, which they impart to other plastics materials are stability to heat and light and unusual resistance to aging. The raw materials used in their manufacture are ethylene oxide, various alcohols, and hydrogen cyanide, all of which are now available in sizable quantities. It is quite likely that the plastics industry is going to hear much more about these acrylics in the next 10 years than they have in the past 10, even though their past use in leather finishes, adhesives, lubricating aids, soil conditioners, and a few other applications has not been insignificant.

Teflon Expansion

CONSTRUCTION of new facilities for the manufacture of Teflon has been started by Du Pont. The new project, planned for completion next summer, will about double the present capacity for making Teflon at the company's Washington Works near Parkersburg, W. Va. This will be an addition to the unit with which Du Pont began the first commercial-scale manufacture of Teflon in 1950.

The projected expansion will cover both major forms of tetrafluoroethylene resin—the powders used in making molded articles and the dispersions employed in manufacturing wire enamels and coated fabrics.

Announcement of the Parkersburg project followed Du Pont's disclosure of a decision to build a new plant at its Louisville, Ky., Works for the production of Freon-22 (monochlorodifluoromethane), a basic material in the production of Teflon.

Improved Plasticizers

FOUR new primary vinyl plasticizers—Dinopol I.D.O., Adipol 810, Kronitex K-3, and Kronitex MX—have been developed by Ohio-Apex Div., Food Machinery & Chemical Corp., Nitro, W. Va. The company makes the following claims:

Dinopol I.D.O. (iso-decyl octyl phthalate) is comparable in price and in most properties to D.O.P. but produces plastics with much lower air loss.

Adipol 810 (iso-decyl octyl adipate) is equal in low-temperature flexibility properties and price to octyl adipate but has much lower volatility.

Kronitex K-3 (tricresyl phosphate) has properties comparable to other tricresyl phosphates but is asserted to have a lower specific gravity and volatility.

Kronitex MX (tricresyl phosphate) possesses properties common in other tricresyl phosphates but has a much lower viscosity and better low-temperature flexibility.

Rigid Vinyl Pipe

NEW rigid Koroseal pipe, said to have exceptionally high-impact resistance, has been announced by James M. Flounders, director of new products development of The B. F. Goodrich Co.'s Industrial Products Div., Akron, Ohio. The pipe has been developed primarily for use in industrial and chemical plants. Mr.

*Reg. U. S. Pat. Off.

Companies you can trust ... trust Norton

● And here's a clear case in point. The Buffalo Meter Company came up with a brand new twist in meter design —a strong, durable, completely waterproof plastic register box to protect their meters from all kinds of outdoor hazards. Norton molded this dome of hard Tenite plastic which gives complete protection against the corrosion, wear and clogging that can put the meter out of commission. The lensatic top of the dome enlarges the meter's dials, facilitating reading. And the unit can be supplied with a gasket to make it water-tight.

Here again, Norton has produced a plastics product that is superior to its forerunners, both in design and utility.

Do plastics fit into your production set-up? Norton's complete plastics service is equipped to design, engineer and custom injection or compression mold plastics to meet your requirements. The results very often include production short cuts that save money, or new finishing and decorating for products that can mean increased sales.

When you think of plastics, think first of Norton for sensible prices, unstinting service and reliable deliveries.

Norton Laboratories, Inc., Lockport, New York
Sales Offices: New York—175 Fifth Avenue; Chicago—5221 Kimbark Avenue; Detroit—3-167 General Motors Building.

NORTON *Laboratories, Inc.*

COMPRESSION AND INJECTION MOLDING

Flounders states that the new material is ideal where chemical resistance, high working pressures, and resistance to impact are required. It is also non-flammable.

The new pipe is available in lengths up to 20 ft. and diameters from ½ to 2 inches. It costs less than equivalent sizes of stainless steel pipe used in applications requiring corrosion resistance. The pipe will be furnished with threaded fittings so that systems may be readily disassembled and reused. Assembly is rapid and requires no special skill or tools.

Pipe can be bent by heating—at 250 to 300° F.—and bending around a form of proper radius. Flanged connections are recommended for joining Koroseal pipe to other pipe systems. Threaded joints can be chemically- or heat-welded for permanent installations and standard metal pipe compounds can be used for temporary joints.

The material will also be used in the manufacture of industrial extrusions and sheets and fabricated products. Other prospective applications include structural and decorative paneling, instrument cases, shipping containers, luggage, valves and fittings, corrosionproof nuts and bolts, gutters, and downspouts. The material can be supplied for these applications in an unlimited number of colors. Excellent electrical properties of the rigid, non-flammable material suggest its use in electrical panels, switch frames, etc.

Soybean-Based Polyamides

POLYAMIDE resins are not new to the plastics industry. Nylon, for example, is a polyamide, but it bears no relationship insofar as the raw materials from which it is made and its basic properties are concerned to the polyamide resins made by General Mills, Inc.

The General Mills polyamides are derived basically from vegetable oils, while nylon is derived fundamentally from coal tar chemicals, petrochemicals, and furfural from oat hulls or corn cobs. In this development, General Mills has raised soybeans back into the plastics picture, although the company is quick to point out that several other vegetable oils may be used as well as that from the ubiquitous soybean. To the chemist, these polyamides are made from dimer fatty acids. Dimers are twin molecules rather than the single molecules found in monomers.

Until recently, the General Mills polyamides have been used primarily for coatings, adhesives, and in printing inks. By using either a hot melt or solvent technique, they provide an unusually glossy coat for paper and at the same time serve as a heat-sealing medium. When used in ink, they give good ink adhesion to glossy or slick surfaces. In adhesives, they improve heat-sealing properties. As a side seam cement for cans, they can be used to replace tin solder in applications where heat is not used in the canning process. Oil cans are an example. One of the most promising of all uses is for paint, where the polyamides are important in the production of a thixotropic paint that will not drip or run.

Thermoset Polyamides—But all of the above uses are for thermoplastic compositions containing General Mills' polyamides. What amounts to an almost entirely new group of thermosetting resins has now been developed. These are produced by combining a polyamide with an epoxy resin in about equal proportions. No catalyst is needed. Polyamide 115 is the reactive polyamide which is used with fluid epoxy resins such as Shell's Epon 828, Bakelite's BRR18795, Ciba's Araldite CN-504, or Borden's Epiphen ER823. The resin blends exhibit exceptional promise in structural adhesives, laminating compositions, embedment compositions, thermosetting coatings, and general low-pressure molding applications. They have a high degree of flexibility and impact resistance, tenacious adhesion to a wide variety of surfaces, excellent resistance to water, and high dielectric strength.

Useful for Laminates—One of the most interesting possibilities is for laminating fibrous glass cloth, mats, or roving. Blends which have sufficient fluidity for dip tank, brush, or roller, and matched die methods of impregnations may be prepared. Outstanding properties are low shrinkage on curing, high structural strength, high dielectric strength, chemical resistance, and excellent toughness. Since Polyamide 115 is, unlike many other laminating resins, an adhesive for untreated glass, its use with fibrous glass appears most advantageous.

Improved Adhesion—Long recognized as one of the severest problems in fibrous glass laminations is that of obtaining permanent adhesion. But here is a resin combination of two of the "stickiest" materials ever known, epoxy and polyamide resin. If they won't make it stick, what will?

In comparing properties of a 6-ply panel made with No. 181 Fiberglas cloth, General Mills' charts show that a 5- by 5- by 0.060-in. panel using Polyamide 115 cannot be easily broken by hand, but that a typical polyester-fibrous glass laminate will break easily; that after reflux in water for 82 hr., there will be no change in appearance and no delamination, while the polyester type turns white and can be delaminated; that dielectric strength after four days' immersion in water will be at least 1000 v./mil for Polyamide 115 and only 140 v./mil for the typical polyester laminate. These, of course, are General Mills' test results, but the company is quite willing to prove the practicality of its experimental testing.

Potting and Casting—The high-dielectric strength and low-shrinkage factor of the non-solvent blends also make polyamide-epoxy compositions promising for potting and casting compositions. The high-impact, compressive, and flexural strength, as well as excellent water, chemical, and solvent resistance of these blends, also contribute to their attractiveness in embedment applications.

In an adhesive system, Polyamide 115 will adhere almost any two known materials together or to themselves. The cost would be slightly lower than with amine-cured epoxy adhesives.

In the protective coatings field, paint resins using the new polyamides have good flexibility, adhesion, impact strength, and chemical resistance. In papers, they can be

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used to make an overprint varnish that will be flexible and scuff- and abrasion-resistant. Company spokesmen say that such a varnish can be applied at one tenth the cost of an acetate lamination job.

General Mills does not sell these combination materials—the company sells only the polyamides. The customer buys epoxies separately and combines the materials in a simple mixing operation.

Requests for samples of the new polyamide resins should be directed to General Mills Laboratories, Chemical Market Development Dept., 2010 E. Hennepin Ave., Minneapolis, Minn.

Alicyclic in Plastisols

REPORTED to be capable of greatly improving the adhesive qualities of vinyl lacquers and reducing viscosity of plastisols is a new versatile alicyclic resin produced by Baird Chemical Corp., 254 W. 31st St., New York 1, N. Y. Designated as Resin MS2, the material is also claimed to increase resistance to ultra-violet light, aid transparency, and resist yellowing.

In plastisols, Resin MS2 replaces from 2.5 to 15% of the vinyl resin. Initial viscosity is improved and viscosity stability is maintained over longer periods of time. As measured by activated carbon extraction, improvements are also found in water absorption and resistance to migration. The material is soluble in and compatible with all commonly used plasticizers.

Technical data bulletin, with tables furnishing complete details on adhesion, viscosity, and other properties of Resin MS2, samples, and prices may be obtained from the company.

Sponge Rubber Company Sold

ANNOUNCEMENT of plans to buy the assets and business of Sponge Rubber Co. and to operate it as the Sponge Products Div. has been announced by B. F. Goodrich Co.

The Sponge Rubber firm is well known as one of the pioneer developers of vinyl sponge as well as a major producer of rubber sponge. It operates plants at Shelton and Derby, Conn., and Fall River, Mass., and has a Canadian subsidiary at Waterville, Que. The company manufactures and sells molded sponge products, rug underlay, foam pillows, furniture cushions, mattresses, insulation materials, and similar items of chemically-blown cellular rubber.

Reports have also been circulated in the trade that Sponge Rubber is acquiring equipment which can be utilized in the manufacture of foamed isocyanate products.

High Flow Styrene

DEVELOPMENT of a new styrene formulation, called Hi Flow 55 Lustrex, reported to have excellent flow characteristics and thus to be especially applicable to pin-point gating, has been announced by Monsanto Chemical Co.'s Plastics Div.

David Guaranaccia, Lustrex sales manager, reports that the material is especially suitable for injection molding of thin-walled items, and that thick-section pieces, such as brush backs, can be molded with Hi Flow 55 with correspondingly lower cylinder temperatures and pressures, thus resulting in finished products with less strain. In many applications, mold cycles have been cut 10 to 15%, and the material molds at 25 to 50° lower than general-purpose styrene.

Nylon for Outdoors

MANUFACTURERS of marine hardware and accessories, who have long eyed nylon hopefully because of its corrosion resistance, toughness, and light weight, but who could not use it because of its instability to light, are now expected to find many uses for Du Pont's new Zytel resin which is resistant to ultra-violet degradation. The company asserts that this new formulation opens to molded nylon fields of applications involving prolonged outdoor exposure.

In appearance, the "outdoor" material is jet black. Preliminary work with this new formulation, called Zytel 105 BK-10, indicates that it is readily moldable with good gloss and is free from smears and dull spots. The properties of the new resin are comparable to those of general-purpose Zytel 101 which is already in wide industrial use as a material for gears, bearings, and complex shapes.

Company officials foresee that much of the new Zytel will also be useful in other applications involving outdoor exposure such as agricultural machinery, sporting goods, toys, and electrical equipment. The new material is also expected to add further impetus to the rapidly expanding use of Zytel in the automotive field.

Vinyl Printing Aid

THE Chem-Dry process, developed by The Meyercord Co., 5323 W. Lake St., Chicago, Ill., is being offered on a license basis for hardening coatings of inks, paints, and varnish. The process is based on the chemical reaction between sulfur dichloride vapor and the vehicle of the coating. It has been proved to be particularly effective for the printing or finishing of plastics sheets and articles.

Although the process operates at ordinary room temperature, it produces in a few seconds or minutes a hardening action which would normally require hours of air drying or baking at elevated temperatures. Articles or sheets travel directly from the printing or coating operations through the Chem-Dry treating chamber and can then be immediately stacked or packaged.

Complete information may be obtained from H. L. Barnebey, exclusive licensing agent, Chem-Dry Process, 550 Grant St., Pittsburgh 19, Pa.

Heat-Resistant Glazing

PROTECTIVE windows in the control cockpits of open-hearth furnace charging machines in the plants of National Steel Corp. are made of a new high-temperature transparent resin called HT-CR-39.

Developed by Cast Optics Corp., Riverside, Conn., HT-CR-39 is reported to have high-impact resistance and to withstand short-duration exposure to temperatures as high as 350° F. with no loss of clarity or rigidity. The material, a copolymer of allyl diglycol carbonate and triallylcyanurate, is also

Lustrex Hi-Flow 55 cuts cycle time up to 15%

Flows faster!

Monsanto's soft-flowing styrene molding powder, *Lustrex Hi-Flow 55* has improved flow characteristics that make molding far easier, faster and more economical.

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Lustrex Hi-Flow 55 styrene molds at 25° to 50°F. *lower* than general purpose styrene!

Cuts costs!

Faster cycles give you easier, more economical production—cut your costs and increase your profits. Yet you maintain quality control, because the lower cylinder temperatures and pressures result in pieces with less strain.

Many uses!

Lustrex Hi-Flow 55 styrene is perfect for packaging and food containers, also for pin-point gating and thin-wall applications where general purpose styrene may have difficulty in filling. It is also ideal for thick-section pieces such as brush backs, and other deep-drawn applications.

Suitable for your equipment!

Works equally well in standard injection, compression and extrusion machines.

Speed cycles—cut costs—boost profits with

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For complete details on Lustrex Hi-Flow 55 styrene molding powder, write: MONSANTO CHEMICAL COMPANY, Plastics Division, Room 2609, Springfield 2, Mass.

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claimed to possess outstanding resistance to abrasion, hot metallic spatter, and all types of chemical fumes and solvents.

Available in sheet form in standard thicknesses up to ½ in., HT-CR-39 is intended for flat glazing applications and cannot be hot-formed.

Samples and a catalog describing the new material and several other special clear plastics may be obtained from the manufacturer.

Less Brittleness

A LETTER from Monsanto Chemicals Ltd., 8 Waterloo Place, London, S. W. 1, England, concerning properties of modified styrene-type compounds reads as follows:

"In the course of reading the very useful article on glass-reinforced polystyrene in the April issue of MODERN PLASTICS, we noted the statement that this material is about as strong at sub-zero temperatures as at normal room temperatures, while any of the modified styrene compounds or alloys have a tendency to become more brittle at low temperatures.

"Though we agree that practically all impact types of styrene do show this tendency to become brittle as temperatures are lowered, we feel that you will be interested in a modified polystyrene just introduced by this company. This modified polystyrene, Lustrex Toughened-1, is unchanged in impact strength over the temperature range of 73 to —76° F. Actual results obtained on comparative tests are shown in the accompanying table.

"While the general toughness and appearance of Lustrex Toughened-1 make it a notable addition to the modified styrenes available for ordinary use, its stability over wide temperature ranges should also be of considerable value for a number of specialized applications."

Impact Strengths of Various Polystyrene Formulations at Different Temperatures (ft. lb./in. of notch: A.S.T.M. D 256-47T)

Material	*73° F.*	*32° F.*	*—22° F.*	*—76° F.*
Lustrex Toughened-1	0.81	0.84	0.87	0.77
Representative High-Impact Styrene	0.94	0.86	0.70	0.46
General-Purpose Styrene	0.37	0.47	0.44	0.49

Polyethylene Rods

EXTRUSION of solid polyethylene rods as large as 6 in. in diameter and 7 ft. long has been announced by H & R Industries, Nazareth, Pa. A special cooling system assures nonporous, void-free stock.

The company also announces the availability of polyethylene sheet for punching and cutting purposes, as well as rod and tube.

Handy

AMONG the scores of items that cross our desk with the claim of being the super-duper answer to all plastics problems, one of the handiest is a lintless wiping cloth or towel produced by The Leshner Corp., Hamilton, Ohio. Designated as Super-Wipe, the new product, made of Viscose fibers, will absorb water twice as rapidly as cotton, according to the president of Leshner. Washing makes it even more absorbent. It is suggested particularly for use on laboratory instruments and in the manufacture of plastics where a lint-free absorbent wiping cloth is a necessity.

Insulating Laminate

TRADEMARKED Rexolite 2101, a new glass-reinforced sheet of thermoset styrene copolymer claimed to possess excellent UHF electrical properties, high-impact strength, excellent punchability, and good machinability has been developed by The Rex Corp., Hayward Rd., West Acton, Mass., producer of Rexolite 1422 UHF insulating material.

The company reports that Rexolite 2101 is produced from a cross-linked copolymer of styrene and has electrical properties which surpass those of thermosetting glass laminates and equal or surpass those of glass-reinforced tetrafluoroethylene.

Lacquer for Polystyrene

PERMANENT adhesion to high-impact polystyrene can now be accomplished with Rez-N-Lac 475, a new quick-drying lacquer developed by Schwartz Chemical Co., Inc., 326 W. 70th St., New York, N.Y.

The company reports that the lacquer was formulated specifically for decorating high-impact polystyrene, to which most lacquers have poor adhesion. Drying time ranges from 1 to 5 min., depending upon whether air-dry or force-dry methods are used.

Plastics Fair in Germany

NON-GERMAN manufacturers of machinery for production of equipment to produce plastics products will be invited to exhibit at Germany's Plastics Fair and Trade Production Show, Oct. 8-16, 1955, in Düsseldorf. Information may be obtained from Nordwestdeutsche Ausstellungsgesellschaft m.b.H. Düsseldorf/Ehrenhof 4, Germany.

Exposure Tests

RESULTS of weathering tests for polystyrene and phenolic molding materials are reported in a paper submitted by J. R. Taylor and C. H. Adams of Monsanto Chemical Co. before a group meeting of the American Society of Mechanical Engineers. The tests were made so that data could be presented on the use of these materials for outdoor purposes. The tests extended over a four-year period and were made in Springfield, Mass., Fort Lauderdale, Fla., and Phoenix, Ariz. Some of the results of these tests are as follows:

Three months' exposure at each location caused serious degradation of the crystal polystyrene as evidenced by pronounced yellowing and crazing. The loss of strength, both tensile and flexural with aging, is directly related to the amount of sunshine falling on the material. Pigmentation of the crystal polystyrene to an opaque gray gave a weather-resistant material showing

little change in strength with four years' exposure. The heat-distortion temperature showed a tendency to increase with the exposure time at all locations. This result appeared to be due to the annealing action of the sun's radiation. The crystal polystyrene annealed at higher rate than the pigmented polystyrene, which was probably due to its greater transparency to infra-red radiation.

Dielectric properties of both crystal and pigmented polystyrene deteriorated with outdoor exposure. Impact strength showed no correlation with either the material or location factors. No trend was established for water absorption behavior.

The phenolic compound, a black, pigmented woodflour-filled material, was degraded mechanically and electrically by semi-tropical weather. Specimens weathered in Arizona, where the relative humidity and rainfall were low, lost weight, mainly by evaporation, but showed no appreciable shift in strength and electrical properties. However, specimens aged in Florida and Massachusetts picked up significant amounts of moisture and thereby lowered their dielectric strength.

Resin for Shell Molds

LOWER costs and improved performance for a wide range of products using metal castings may be possible as the result of two new liquid resins for making shell molds and cores developed by Reichhold Chemicals, Inc., 525 N. Broadway, White Plains, N. Y.

The liquid resin for shell molds, called Reichhold Foundrez 7429, is combined with sand in the proportion of 100 parts of sand to two parts of resin. Shell molds made by the new R.C.I. process have been employed with what is reported as complete success in pouring stainless steel at temperatures as high as 3100° F., and aluminum at approximately 1350° F.

The quality of finished castings produced by the new process is in every way comparable to that of castings produced by the Croning processing, and is achieved with the use of less than one-third of the amount of resin required in the latter process, according to Reichhold officials.

In the making of cores, the R.C.I. process is based on the mixing of 100 parts of sand with two parts of Foundrez 7581, another new water-soluble Reichhold resin.

An advantage of the company's new core process is that it produces cores having the smooth finish hitherto obtainable only by shell mold processes. One motor manufacturer who has tried the new Reichhold core-making process estimates that if port cores, manifold cores, and combustion chamber cores for an engine were made by the process, horsepower would increase 5 to 10 percent.

Ink for Wet Surface

AN INK for identification markings which can be applied to wet surfaces of plastics and metals with an ordinary rubber stamp and pad has been developed by Organic Products Co., Box 428, Irving, Texas.

Designated as No. 400 Wet Surfaces Ink, the product is claimed to be applicable to almost any surface that is submerged in water, or immediately after withdrawal, while still wet or damp. Drying is fast because the ink "water-sets." However, water carried into the pad does not affect the marking. There is no bleeding of color into the water.

Bulletin No. 400, furnishing full information about the new product, may be obtained from the company.

High-Pressure Reinforced Parts

NOW available from American Hard Rubber Co., 93 Worth St., New York, N. Y., are high-pressure compression and transfer-molded parts of fibrous glass reinforced plastics. High-pressure molding of resin impregnated fibrous glass differs from low-pressure operations in that varying section thicknesses, complex details, and multiple inserts requiring flow of material around the inserts can be obtained.

The company's process consists of loading the mold or transfer pot with a measured charge of resin-glass compound, forming to shape by closing the press, and then curing under heat and pressure. The compound is a mixture of resin (usually polyester), catalyst, filler, and chopped fibrous glass. Cavity pressures in the order of 2000 p.s.i. are required.

Reinforced Vinyl Fabric

FULL production of Filmtex, a new reinforced vinyl fabric, has been anounced by Toscony Fabrics, Inc., 303 Fifth Ave., New York 16, N. Y. The vinyl-to-cloth laminate is claimed to have unlimited applications to low-cost volume merchandise in the housewares, juvenile, notions, and novelty fields.

Toscony asserts that Filmtex brings to the manufacturer a competitively priced material in a wide range of colors and patterns never before available in lightweight supported films. It combines all the inherent virtues of both cloth and vinyl and makes possible product applications never before feasible.

The material has been tested in many product areas and has been readily accepted for baby accessories, yard goods, mattress covers, outdoor furniture, and many other items where added strength, more colorful patterns, and simplified cleaning is desirable.

Complete information, prices, and samples may be obtained from Toscony.

Better Color

DEVELOPMENT of a new light-stable formulation of polystyrene, significant to the lighting field, has been announced by The Dow Chemical Co., Midland, Mich. It is claimed that the new material, called Styron 647, offers eight to ten times better light stability than general-purpose polystyrene. Stabilization of the material results in non-yellowing crystal and white colors.

Dow has also introduced seven new colors for the plastics housewares market. The company points out that in making color choices, producers of plastics raw materials must take into consideration the following factors: 1) the plastics housewares market is a mass market; 2) price range of plastics housewares items is low—10¢ to $6; 3) the market is not highly selective; and 4) the molder of housewares

How can new A-C* Polyethylene fit into your picture?

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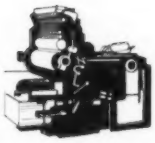
Dairy Cartons

For Upgrading Petroleum Waxes

Polishes



Printing Inks of All Types

OR OTHER USES such as . . .

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- for leather treatment
- in varnishes and water paints
- in cosmetics
- as a lining for metal containers
- in manufacture of candles
- as a protective coating
- for latex dispersions
- in investment wax
- as a lubricating aid in processing plastics
- for fabricating and waterproofing

A-C POLYETHYLENE—in its present form—is a low molecular weight polymer that shows great promise as an ingredient for various film-forming materials. In appearance it is translucent white in color! And it is tasteless . . . substantially odorless . . . non-toxic!

THIS VERSATILE NEW material has a low density, is resistant to most chemicals at room temperature, as well as to water. In addition, it has excellent electrical properties.

ONE OF THE BIG ADVANTAGES A-C POLYETHYLENE has over similar materials is *low viscosity*. And it is readily compatible with most waxes and wax-like materials. These highly desirable properties also make possible close formulation control. As a result of this ease of dispersion and retention in solution, these advantages enable you to self-blend compounds used in paper coating and in certain other operations. It's easier to handle . . . easier to blend . . . easier to use!

A-C POLYETHYLENE is supplied in several grades. It can also be supplied in various low molecular weight grades that are readily emulsifiable, more soluble and dispersible.

physical properties

	*6	*7	*615	*617
Av. Mol. Wt.	2,000	2,000	5,000	1,500
Melting Point °C.	97-102	102-106	102-104	88-90
Hardness mm. 75°F.	0.3-0.5	0.2-0.3	0.3-0.4	2.0-2.5
Specific Gravity	.92	.92	.92	.92
Viscosity at 140°F.	300 cps.	400 cps.	4,000 cps.	110 cps.

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items should stay away from "fad" colors. A few well chosen colors added to a line of standard colors periodically is better than offering a wide range of doubtful colors at one time.

Also reported by Dow is the reduction in price of styrene oxide in tank car lots. The material now sells for 70¢ a lb. in contrast to the former price of 95¢ a pound. Styrene oxide is being used principally as a reactive diluent in epoxy resins and in the synthesis of aromatic compounds.

Big, Even for Texas

SOMETHING big and unusual is going on in plastics in Texas where, of course, it might be expected to be big and unusual. Company officials of Texas Plastic Development Corp., 3638 University Blvd., Houston 5, Texas, claim that they are now producing flexible vinyl irrigation tubing in sizes from 2 to 24 in. in diameter. A 24-in. vinyl tube is really something to think about.

Texas Plastic also announces that it is manufacturing Tex Test Boat Rem which is claimed to be a new and improved method of fibrous glass coating for boats, and that it will expand into fabricating and laminating fibrous glass for such other uses as drain boards, shower stalls, sinks, walls, etc.

Company spokesmen say that their organization is strictly a development corporation to further the interest in plastics.

Resin for Embedments

CASTING resin for producing electronic embedments has been developed by Emerson & Cuming, Inc., 869 Washington St., Canton, Mass. The material, called Stycast 2850 GT, is claimed to have an extremely wide temperature range of usefulness extending from —100 to 400° F. For short periods, it can be used at 500° F.

The cured plastic is reported to have a thermal coefficient of expansion approximately the same as that of aluminum and brass. This means that even large metallic inserts can be embedded without cracking on temperature cycling. Other important features claimed for Stycast 2850 GT are low shrinkage during cure, good adhesion to a variety of materials, and the possibility of room temperature cure.

Stycast 2850 GT has been found useful in embedding such diverse components as power transformers and transistors, as well as complete electronic circuits. It has a reported heat distortion point of 347° F. and dielectric strength (v./mil) of 455.

Reclaiming Potted Parts

ELECTRONIC components that have been encased with epoxy or polyester resins may be reclaimed from rejects by use of De-Solv 292, according to Ram Chemicals, 200 E. Olive St., Gardena, Calif., producer of this solvent. By immersing the embedded item in De-Solv 292, the epoxy or polyester resin will disintegrate and the components can be readily removed.

The solvent has been found suitable for use on parts based on nylon, Formvar, and linen-wrapped wires in reclaiming operations. In addition, it is not harmful to phenolic-base systems such as printed circuits. De-Solv 292 is a non-flammable, neutral solvent combination of low toxicity.

New Cast Film Producer

A NEW chemical company, Mono-Sol Corp., has been established in the Gary, Ind., area for the manufacture of polyvinyl chloride and polyvinyl alcohol film and sheeting. The polyvinyl chloride is expected to be used for dustproof, transparent protective covers, raincoats, and curtains. Other uses will include packaging for frozen foods, fresh vegetables, vacuum pack, desiccated foods, and chemicals.

Polyvinyl alcohol film is used extensively by the plastics industry as a mold release for thermosetting resins in the fabrication of table tops, airplane parts, automobile bodies, boats, etc. It is extremely resistant to fats, oils, and waxes and has phenomenal tear strength. This type of film can be made water-soluble and will be of interest to packers of dyes, detergents, soaps, and chemicals where a preweighed amount can be added to a batch without removing the wrapping material.

Operating head of the new corporation is E. M. Kratz, vice president, with M. H. Sprague as general superintendent, and C. S. Quillen in charge of chemical research. The latter two were until recently associated with the Gary Div. of Reynolds Metals Co.

Phenolic Stampings

LOW-COST, short-run phenolic stampings to meet requirements for radio and electronic frames, insulators, panels, socket bases, mechanical gaskets, spacers, and cams are available from Federal Tool & Mfg. Co., 3600 Alabama Ave., Minneapolis 16, Minn.

The company states that phenolic stampings can be die-cut to specifications by "controlled tolerance" methods, holding tolerances to ±0.002 in. under standard conditions.

Used for experimental projects, pilot runs, or limited quantity production, the phenolic stampings can be produced in any size or shape up to 9 by 12 by ⅛ inches.

Solvent With a Future

CALLED a close approach to the mythical universal solvent, Du Pont's dimethyl formamide has been gradually acquiring a reputation during its four-year commercial life for dissolving materials rated as tough to dissolve. Here are some of its applications in the plastics field.

While D.M.F. is essentially a non-solvent for straight polyvinyl chloride resin, it does improve the solvent power of such other solvents as tetrahydrofuran in combination with methyl ethyl ketone. For this reason it is used with printing inks for vinyl film. These inks often consist of 95% polyvinyl chloride and 5% polyvinylidene chloride, and are unusually hard to dissolve. But the combination using D.M.F. will reportedly do the trick and offers volatility, greater versatility in cost, and a chance to use less soluble resins for printing.

Work is also being conducted on the possibility of applying polyvinyl chloride resin using D.M.F. in synergistic solvent combination at

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PARAPLEX G-40

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Where vinyl products must stand up for years under all kinds of abuse, permanent plasticizers are essential—for loss of plasticizer invariably means embrittlement and service failure. Choose one of these PARAPLEX polymeric plasticizers, and you can expect high quality service throughout the life of your product.

PARAPLEX G-25 has long been recognized as the best plasticizer for all-around performance and long life. Non-volatile, non-migratory, highly resistant to extraction by water, oil, and gasoline.

PARAPLEX G-40 is a lower cost plasticizer, which has many of the properties of PARAPLEX G-25. It has better color, oil resistance, and resistance to migration into rubber.

PARAPLEX G-50 is the most economical of the permanent plasticizers, representing an excellent compromise between quality and cost. It is easy to handle, and is an excellent pigment grinding medium.

PARAPLEX G-53 is a highly permanent plasticizer, combining moderate price with resistance to extraction by oil, soap, or water, and freedom from migration, particularly into polystyrene.

CHEMICALS FOR INDUSTRY

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THE RESINOUS PRODUCTS DIVISION

Washington Square, Philadelphia 5, Pa.

Representatives in principal foreign countries

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room temperature rather than in hot M.E.K. to give a protective finish for previously printed vinyl film.

Other resin solvent jobs for dimethyl formamide include its use in air-dried spray coatings such as aircraft lacquers, knife coatings, calendered coatings, and adhesives. The claim is made that D.M.F. will increase solids without affecting evaporation and viscosity adversely, thus proving economically acceptable.

Distributor for Vinyl Pipe

A MAJOR products supplier has added rigid vinyl pipe and fittings to its large distribution network, according to the manufacturer, Alpha Plastics, Inc., West Orange, N. J.

The distributor, Whitehead Metal Products Co., Inc., 303 W. 10th St., New York 14, N. Y., will offer Alpha's vinyl pipe in addition to the company's 40-yr. old established lines of metal stocks. Whitehead will have representatives and distribution centers in 12 cities.

Trouble Shooter for Shell Molding

ESTABLISHMENT of a new experimental shell-molding foundry, with complete facilities for making shell molds and pouring castings, has been announced by General Electric Co.'s Chemical Materials Dept., Pittsfield, Mass.

S. L. Brous, general manager of the department, states: "This facility will enable G-E to make a contribution to foundry technology in solving problems such as satisfactory casting of low-carbon steel in shell molds. In addition, the experimental foundry will permit constant testing and improvement of G-E phenolic resin for the shell-molding process, as well as provide trouble shooting service for foundry customers."

Industrial consumption of phenolic shell-molding resins is expected to exceed the 25-million lb. mark by 1957. Over 8 million lb. were consumed last year by the foundry industry, say G-E officials.

General Electric currently manufactures both of the synthetic materials required for the new shell-molding process—phenolic resins (the adhesive agent for bonding shell halves together), and silicone (the parting agent for releasing shell molds from their metal patterns).

Melamine-Canvas Laminate

INTRODUCTION of Panelyte Grade 471 for use in TV high-voltage insulation has been announced by St. Regis Paper Co.'s Panelyte Div., 230 Park Ave., New York 17, N. Y. The new laminate, which provides an economical approach to a serious technical problem in the TV field, is claimed to be superior to other high-insulation materials in water absorption, dielectric strength, power factor, arc resistance, and with-grain flexural strength.

The melamine-canvas grade has the added advantage of flame retardency, which makes it valuable for such applications as terminal boards, filament holders, high-voltage shields, and fly-back transformers. It is claimed to be superior to paper-base, high-insulation materials because of its resistance to arcing and burning.

The following data are based on the $^1/_{16}$ in. thickness of Panelyte Grade 471:

Density	1.51
Water Absorption	1.25
Dielectric Strength	90
Power Factor	.045
Arc Resistance	180
Insulation Resistance	250
With-Grain Flexural Strength	25,000
Flame Resistance	15 sec. test—no effect

Plexiglas Extruded Sheet

COMMERCIAL production of Plexiglas extruded sheet has been announced by Rohm & Haas Co., Philadelphia 5, Pa. The extruded material is priced lower than cast sheets and is suitable for outdoor as well as indoor applications, according to the manufacturer.

Plexiglas extruded sheets are available in thicknesses of 0.060, 0.808, 0.100, and 0.125 in.; in widths of 36 and 48 in.; and lengths from 48 to 96 inches. The material is produced in both clear transparent and white translucent form.

The company states that extruded sheets are expected to open up new fields of application where there has been a need for thin-gage, lower-priced material with the general properties of cast acrylic.

Plastics Promotion

PLANS for promoting products made from Monsanto plastic resins include a morning television show, which started late in July, designed to increase consumer understanding of plastics. Twenty-five of this year's commercials are being devoted to Lustrex housewares, 10 to Ultron vinyl film products, and 10 to Lustrex wall tile.

Another step in Monsanto's plans to help the consumer understand plastics is the announcement that the third of seven films describing ways of making modern homes more attractive had been completed. Entitled "Green Thumb Decoration," the film will feature pets, planters, and plastics.

All three films are available gratis to television stations, department stores, and interested groups. Requests may be directed to Department SM, Monsanto Chemical Co., Plastics Div., Springfield, Mass.

Architectural Plastics

A NEW company, Plasti-Products Co., 1355 River Rd., Eugene, Ore., has been formed to specialize in furnishing complete service for all plastics materials of any significance to architecture. The company will carry in stock all types of plastics items that are likely to be used in the building industry. Plasti-Products states that its purpose is to make these products available to architects and engineers just as lumber, glass, masonry, concrete, and metals are made available by building supply companies.

Some of the products the firm will carry are sheetings that have such materials as vinyl or polyethylene sprayed on them for chemical and moisture resistance; sheets and films such as acrylics, cellulosics, polyethylene, and polyester-fibrous glass; foamed plastics for insulation; and panels for luminous ceilings.

The company is equipped to install or apply most technical applications of architectural plastics. Factory-trained spray applicators,

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for example, are available for contract applications of sprayed sheetings. The organization will be able to fabricate original decorative translucent panels to specifications, using acrylic or vinyl laminates. The architectural staff will offer professional services in the particular use of these materials.

Radioactivity for Plastics

A SYMPOSIUM on the applications of radioactivity in the rubber and plastics industries will be held at the Sheraton Plaza Hotel, Boston, Mass., October 6-8, under the sponsorship of the Technical Div. of Tracerlab, Inc. The aim of the symposium is to acquaint members of the plastics and rubber industries with the past uses, and possible future applications, of radioisotopes in research, development, and process control.

The first day will be devoted to orientation talks directed to those persons who are contemplating the use of isotopes. The second and third days will be taken up by technical papers on such topics as the kinetics of polymerization, initiation of polymerization by ionizing radiation, wear tests, thickness gaging, etc.

The registration fee will include admission to all sessions, abstracts of talks, and a dinner preceded by a cocktail party on October 6, featuring a speech by a nationally prominent figure in the field of atomic energy.

Additional information may be obtained by writing to the Symposium Committee, Technical Div., Tracerlab, Inc., 130 High St., Boston 10, Mass.

Benzoic Acid for Plastics

DEVELOPMENT of a new series of eight benzoic acid esters of polyalkylene glycols may open broad commercial possibilities in plastics, lubricants, textiles, and flotation, according to Tennessee Products and Chemical Corp., Nashville, Tenn.

These products, marketed under the tradename of Benzoflex with identifying numbers, are characteristically light-colored, mild-smelling, high-boiling, and stable esters. They possess a wide viscosity range and vary in freeze points and solubilities.

Two esters, diethylene glycol dibenzoate (Benzoflex 2-45) and dipropylene glycol dibenzoate (Benzoflex 9-88), are primary plasticizers for vinyl chloride resins, and they substantially lower time and temperature required to process these resins. Benzoflex 9-88 is the first commercial low-freezing plasticizer of its type to be introduced. Both esters are available in commercial quantities.

The higher glycol dibenzoates are compatible with selected vinyl resins, including polyvinyl acetate; polyethylene glycol dibenzoates exhibit compatibility with phenolformaldehyde resins, imparting flexibility and improved adhesiveness to these polymers. These higher glycol dibenzoates are available in pilot plant quantities.

Technical data and experimental samples are available from the company upon written request.

Foam Plastics

SEVERAL developments in the improved formulation and manufacture of foam plastics have been announced by Foam King, Inc., 110 W. 34th St., New York 1, N.Y.

Two types of foam plastics are available from the company—open air cell and closed air cell. The open air cell foam results from a formulation which obviates pressure tanks and pressure molds. The common method presently employed by most companies is to add an inert gas by whipping it into the plastisol under pressure. The mix is then poured in its cellular stage from the pressure tank into a mold and fused.

In contrast, the Foam King method utilizes a prepared plastisol, which, when poured into a mold (open or closed), will rise to a controlled and predetermined height and density under the application of low-temperature heat. It is then fused at a higher temperature. The result is a foam plastic with good tensile strength and resiliency, excellent recovery, and complete uniformity in cell structure. The texture can be varied from a superfine cell structure to extra large cells.

The closed cell foam, called Closell, also employs a strictly chemical approach. Without using pressure molds or high temperatures, this unicellular sponge is made in open molds, atmospherically.

Closells are actually millions of nitrogen-filled sealed cells, each independent of the other and yet all fused together in a single sheeting. The material is light in weight, soft, and pliable, and offers protection against the penetration of air, dust, and water.

Both types of foams—open cell and closed cell—possess common qualities such as flexibility, resistance to rot and mildew, oils, greases, alkalies, acids, and most chemicals. They are unharmed by the elements and will not dry out or crack. Both products will meet the requirements of fire codes for non-flammability.

Gold Ink

NON-TARNISHING vinyl ink concentrates, in rich gold and pale gold shades, are being offered to gravure and silk screen printers of vinyls by Claremont Pigment Dispersion Corp., 110 Wallabout St., Brooklyn 11, N. Y.

Tarnish-free gold effects have been produced on flexible and rigid vinyl materials through both of these printing processes. It is reported that no discoloration is exhibited by prints which have been exposed to light under standard Fade-Ometer conditions for 400 consecutive hours.

Nylon-to-Vinyl

RUGGED nylon-to-vinyl adhesion can now be built into nylon-supported vinyl sheeting on standard combining equipment. Successful laminates have been fabricated at costs of approximately one cent per yd. of 54-in. material.

Claremont Pigment Dispersion Corp., 110 Wallabout St., Brooklyn 11, N. Y., claims to have made this achievement possible through its newly developed Vinyl Combining Cement, D-456. Laboratory tests on 8-mil vinyl sheeting bonded to nylon tricot indicate a strength of 40 lb. per linear inch.

The company claims that application of the adhesive in film thick-

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nesses up to ½ mil is sufficient for good performance. Lamination can then be immediately effected by passage of both webs simultaneously through a laminating machine or a calender. Pressures ranging from 5 to 10 p.s.i. have met the requirements for perfect lamination, under the temperature conditions specified.

EXPANSION

Du Pont announces that a new research laboratory for its Film Dept. will be constructed at the company's Experimental Station in Wilmington, Del. The laboratory is scheduled for completion by the end of 1955.

The new building, representing an investment of $1,275,000 in facilities for fundamental and long-range research, will be the first major laboratory addition to the Experimental Station since the dedication in May 1951 of the station's expanded facilities, which was built at a cost of over $3 million.

The laboratory, which will be in addition to the department's present research laboratory in Buffalo, N. Y., will be devoted primarily to exploratory research in synthetic polymers for the general field of packaging and industrial films.

While it is expected that some technically-trained employees will move from Buffalo to Wilmington when the new building is completed, it is anticipated that the activities of the Buffalo laboratory will continue as a major research operation. At present, a second semi-works building is under construction there.

Alsynite Co. of America, 4654 De Soto St., San Diego 9, Calif., has opened its third manufacturing plant at 300 E. 18th St., Paterson, N. J., with **C. J. Opel** in charge.

Sales for the company have grown from a quarter-million-dollar figure in 1949 to an anticipated high of $6,500,000 this year. The new Paterson plant will reportedly enable Alsynite to boost its 1955 sales volume to over $10 million.

The firm has nine regional offices, 13 sales executives, 150 national stocking distributors with over 1200 Alsynite salesmen in the field. A dealer organization of over 6000 retail outlets supports this national distribution.

The Dow Chemical Co. has completed new facilities at Midland, Mich., for the production of Bis phenol-A, doubling capacity for this product.

Most of the expanded production will go into the fast-moving epoxy resins which have been skyrocketing since World War II. Bis phenol-A is a basic building block in their manufacture.

Angier Products, Inc., 120 Potter St., Cambridge 42, Mass., custom manufacturers of rubber cements and adhesives, has started construction on a manufacturing plant and sales office located in Huntington, Ind.

The laboratory and sales office, headed by **John J. Kerr**, will enable Angier to expedite shipments and solve technical problems without delay. Plant operation is scheduled about October 1.

Printloid, Inc., 93 Mercer St., New York 12, N. Y., announces that it has expanded its printing facilities by installing new equipment which is capable of printing on plastics sheets of various thicknesses and sizes up to 21 by 28 inches.

Oneida Paper Products Co. announces that construction of its fifth plant is nearing completion in Centralia, Ill. Occupying over five acres, the Centralia plant will manufacture a complete line of flexible packaging materials, including multi-printed sheets and rolls, cellophane, polyethylene, Polyply, glassine, and various other grades of transparent and semi-transparent bags.

COMPANY NOTES

Bigelow-Sanford Carpet Co., Inc. has acquired the assets of LeConte Plastics Co., Inc., Farmingdale, N. Y., which will become a part of Bigelow's Special Products Div. The manufacturing facilities of LeConte will be moved to Bigelow's Amsterdam, N. Y., plant. **Charles LeConte** has been named general manager of Bigelow's reinforced plastics operations.

Hale & Kullgren, Inc., Akron 9, Ohio, announces the appointment of **Richard K. Senn** and **Merrill T. Ham** as project engineers. Both appointees will specialize in new plant layouts and automation in connection with the company's work of designing machinery and processes for plastics and rubber. Mr. Senn was formerly affiliated with The Goodyear Tire & Rubber Co. and National Rubber Machinery Co. Mr. Ham comes from Monsanto Chemical Co.

Sundberg-Ferar, Royal Oak, Mich., has opened a New York office at 10 E. 49th St., with **Richard W. Figgins** in charge.

The Jamison Plastic Corp. has moved its plant and offices to a new building located at 1255-75 Newbridge Rd., N. Bellmore, N. Y.

Case Institute of Technology, 10900 Euclid Ave., Cleveland, Ohio, has signed a two-year Government contract engaging in the study of possible replacement materials for critical metals used in Army medical equipment. The contract calls for two general phases of research: 1) study of the physical and chemical properties of possible replacement materials such as plastics, ceramics, wood, and less critical materials; 2) engineering design of specific items for later assembly into models for field and laboratory tests.

Carlon Products Corp., 10257 Meech Ave., Cleveland 15, Ohio, announces that **Thomas W. Dunn** has been named general sales manager. His headquarters will be in Cleveland and he will be in charge of sales of the company's plants in Klamath, Ore.; Corsicana, Texas; Denver, Colo.; Upper Sandusky, Mantua, Auburn Corners, Cleveland, Ohio; and Asheville, N. C. **E. S. Moreland** will act as assistant general sales manager. Formerly sales director of the company, Mr. Moreland is now curtailing his activities because of ill health.

The Goodyear Tire & Rubber Co.'s Chemical Div., Akron 16, Ohio, has assigned **Edward C. Brown, Jr.**, **James F. Carraher**, and **Earl Scott** to its sales service section. Mr. Brown will provide technical as-

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sistance to customers in the use and application of Plio-Tuf, Goodyear's new high-impact thermoplastic molding resin; Mr. Carraher will furnish technical and engineering service on vinyl resins; and Mr. Scott will handle technical sales service on the company's various synthetic latices.

Stillman Rubber Co., Culver City, Calif., has established a Polyvinyl Div., which will make molded polyvinyl chloride products for industrial use.

Chicago Molded Products Corp., 1020 N. Kolmar Ave., Chicago 51, Ill., announces a new slate of corporate officers as follows: **Edward F. Bachner, Sr.** has been appointed to the newly created post of chairman of the board; **Marcel F. Bachner** has been elected president and treasurer; and **John J. Bachner** has been promoted to executive vice president and general manager.

JOHN J. BACHNER

The company has been engaged in plastics processing for 36 years and claims to be a pioneer developer of such significant plastics products as radio cabinets, washing machine agitators, and organ keys. Its most recent "first" is a television cabinet of colored urea. Today the company's products range from tiny nylon gears and camshafts for electric razors to 35-lb. phenolic cabinets for television sets. A recent expansion was the new $600,000 plant to produce more than 600,000 lb. per month of Campco rubber-modified styrene sheet.

General Electric Co., Pittsfield, Mass., announces the formation of the Chemical and Metallurgical Div., which includes the former Chemical Div. and Carboloy Dept. **Robert L. Gibson** has been named general manager of the new division. It will consist of five operating departments—Carboloy, Plastics, Silicone Products, Chemical Materials, and Laminated & Insulating Products. Under the new arrangement, the former Chemical Div.'s four operating departments will remain unaffected; their general managers will continue to report to Mr. Gibson.

The Chemical Materials and Plastics Depts. are headquartered in Pittsfield, while the Silicone Products and Laminated & Insulating Products Depts. are respectively located in Waterford, N. Y., and Coshocton, Ohio.

G-E also announces the following appointments: **Richard T. Walsh** has been named supervisor of molded laminated products; **Ronald W. Staley** as supervisor of insulating products engineering; and **Carl A. Drake** as superintendent of the Coshocton plant. **Frank N. Kautzmann, Jr.** is now advertising and sales promotion manager of the Laminated & Insulating Products Dept.

A new Sales and Product Planning Unit has been established and **Bernard F. Brehl** has been appointed manager of the unit.

Godfrey L. Cabot, Inc., Boston 10, Mass., has opened a new sales office in the Board of Trade Bldg., 141 W. Jackson Blvd., Chicago 4, Ill., under the direction of **Francis H. H. Browning.** The new office will handle sales of all Cabot products to customers in the Illinois, Minnesota, and Wisconsin areas.

Reichhold Chemicals, Inc. has obtained additional space at 525 N. Broadway, White Plains, N. Y. All Sales as well as Foreign and Export Depts. will move to White Plains along with all divisions and personnel connected with administration of both Reichhold's national and international operations.

Duplicon Co., Inc., Turnpike Rd., Westboro, Mass., small-lot stampers, has organized a Sheet Plastic Forming Dept. The new department will supply formed plastic sheet covers, cases, and deep drawn parts.

Rogers Corp. changed its address on August 1. On that day, Goodyear, Conn., where the company had its main plant and general offices, took the name of Rogers, Conn. The change was based on a petition to the Post Office Dept. by a majority of local boxholders. The company has consolidated its administrative facilities in Rogers. Plastics manufacturing facilities will be continued in Manchester, Conn., where the company has been located since 1832. All mail to the company should be addressed to Rogers, Conn.

Alsteele Engineering Works, Inc., 82 Herbert St., Framingham, Mass., has appointed **Western Molders Supply Co.**, 536 N. Robertson Blvd., Los Angeles, Calif., as its West Coast representative.

Bradley Container Corp., Maynard, Mass., announces that **Dick Muller** has been appointed Midwest sales manager and **Clint Booth** West Coast district sales manager. Mr. Muller was formerly associated with Plax Corp. as Chicago district manager for 6½ years.

Reilly Tar & Chemical Corp. has opened a new sales office in the Green Bldg., 2009 Fannin St., Houston 2, Texas, under the supervision of **Donald Becker.**

Duralastic Products Co., 2075 W. Lafayette Blvd., Detroit, Mich., has retained **J. T.** and **J. H. Libbey**, 5432 Cass Ave., Detroit, as its custom molding representatives in Michigan.

Plasticrafters, Inc., 1829 S. 55th Ave., Chicago 50, Ill., is a new company engaged in molding of all types of thermoplastic and thermosetting materials. The company's equipment consists of both compression and injection molding machines. The premises are those formerly occupied by Industrial Plastics Corp.

James A. Boyajian, president of Plasticrafters, has been a plastics consultant, consulting engineer, and is an instructor of plastics engineering at Northwestern University and has been teaching there for the past 15 years.

Dec-Art Process Co., Inc., 349 Canal Place, Bronx 51, N. Y., has been recently formed and will specialize in spray-decorating. The company is equipped with automatic multiple spindle- and mask-type spraying machines and automatic conveyor-type baking machines.

The Sierracin Corp., 1121 Isabel St., Burbank, Calif., announces that **Douglas G. Wilkings**, former opera-

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tions manager, has been elected vice president and **William W. Benson, Jr.**, treasurer of the company, has been elected to the additional office of secretary. During Mr. Wilkings 17 years in the plastics business, he has been associated with New Plastic Corp., Olympic Plastics Co., and Calresin Corp.

Southwestern Plastic Pipe Co. has sold its common stock to **Texas Vitrified Pipe Co.**, Mineral Wells, Texas. Southwestern will operate as a division of Texas Vitrified, producer of vitrified clay products.

Marbon Corp., Gary, Ind., announces that **Dr. Andrew P. Ting** and **T. C. Alexander** have been added to the company's chemical research laboratories. Marbon, a subsidiary of Borg-Warner, produces high-styrene resins for the plastics, rubber, paint, and rubber-to-metal adhesives industries.

Spencer Chemical Co., Dwight Bldg., Kansas City 5, Mo., has appointed three district sales managers to head its new district sales operations for industrial chemicals in New York, Kansas City, and Chicago. The reorganization signals Spencer's planned entry into the polyethylene field and general expansion in industrial chemicals.

The new territory heads are: **George N. Olson** as New York district sales manager, **Howard Millington** as Kansas City district sales manager, and **H. R. "Dick" Bishop** as district sales manager for the Northcentral district of Chicago. Mr. Olson has been with the company's Industrial Chemical Sales Dept. since 1948; Mr. Millington joined Spencer in 1942 as a technician at the Jayhawk Works in Pittsburg, Kan.; and Mr. Bishop comes to the company from Armour Chemical Div.

Du Pont has transferred **Norman W. Todd** and **Dr. Harold C. Barker** from its Polychemical Dept.'s research staff to the department's sales service section. Mr. Todd and Dr. Barker have been scheduled to join other engineers and chemists to study plastics fabrication in the department's new $3 million sales service laboratory now under construction in Wilmington, Del.

Bakelite Co., a Div. of Union Carbide and Carbon Corp., 260 Madison Ave., New York 16, N. Y., has entered into an experimental licensing agreement with **Elastomer Chemical Corp.**, Newark, N. J., under the patents held by Elastomer for foaming vinyl resin plastisols.

Bakelite has been licensed under Elastomer's patents for experimental purposes and is prepared to work cooperatively with all other licensees under those patents in the commercial application of Bakelite vinyl resins to this newly developing field.

I. B. Kleinert Rubber Co., 485 Fifth Ave., New York 17, N. Y., announces the election of **Harry A. Kleinert, Henry J. Fine**, and **LeRoy Clayfield** as new directors of the company. Mr. Kleinert joined the organization in 1927 and since 1942 has been superintendent of Kleinert's plant in College Point, N. Y. He succeeds his father, Harry I. Kleinert, on the board, who has been a director for 28 years. Mr. Fine, who has been with the company for 19 years, is production manager of the College Point plant. Mr. Clayfield, merchandise manager, has been with the firm since 1930.

Fiber Glass Div., Libbey-Owens-Ford Glass Co., Toledo, Ohio, announces the following promotions:

James J. Secor, Jr., formerly with the New York district office, has been appointed Philadelphia district manager; **Chester E. Shepperly**, former field representative for industrial sales of flat glass in Dayton, Ohio, has been transferred to the Fiber Glass Div. and will supervise the Boston, Mass., district office; and **G. O. Hartzell**, formerly a Toledo field representative, is now manager of that office.

Molded Fiber Glass Body Co., 4601 Benefit Ave., Ashtabula, Ohio, announces the election of the following officers: **Robert S. Morrison**, president; **Morgan Martin**, vice president in charge of engineering; **Robert L. Wiese**, vice president in charge of manufacturing; **Theodore E. Warren**, secretary; and **Mrs. Mary A. Domizi**, treasurer.

Consoweld Corp., Wisconsin Rapids, Wis., has appointed three regional field representatives as follows: **Don H. Farrish** has been named representative for the North Central states, **Tom F. Davies** for nine West Coast states, and **Pressley Walker** for the Southeastern states.

PERSONAL

Dr. Augustus B. Kinzel has been appointed director of research of **Union Carbide and Carbon Corp.**, 30 E. 42nd St., New York 17, N. Y. He will be responsible for the administration and coordination of the research activities of all divisions of Union Carbide.

Alan S. Cole, executive vice president of MODERN PLASTICS and other Breskin Publications, has been named a member of the board of directors of the Associated Business Publications.

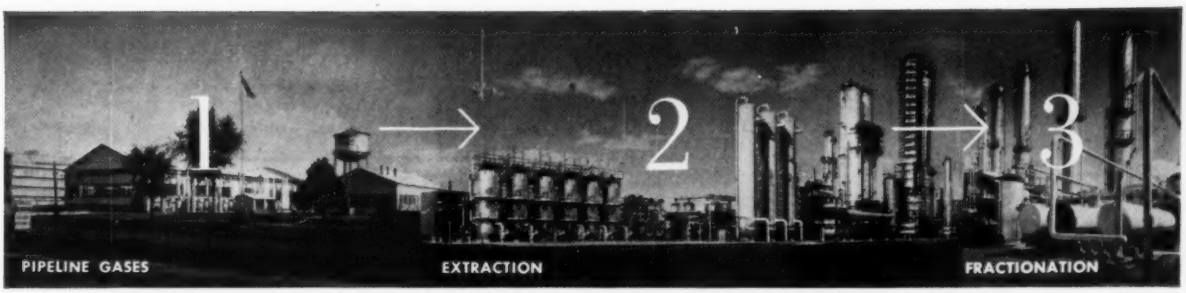
J. A. Cooper, 6516 Kenview Dr., Cincinnati, Ohio, has joined **Detroit Plastic Products Co.**, 21614 Groesbeck Highway, E. Detroit, Mich., as a sales representative. He will handle industrial accounts in and around the Cincinnati area.

Robert E. Munsell has joined **American Resinous Chemicals Corp.**, Peabody, Mass., as New England technical representative. Mr. Munsell has been in charge of technical development of Stein-Hall & Co.'s Latex Compounding Dept. for several years.

Roy T. Hanson, formerly assistant manager of **Borden Co.'s** West Coast operations, has been named Western manager of the company's Chemical Div. He succeeds **William R. Moffitt**, who was recently appointed a vice president and technical director of the division, with headquarters at the main office, 350 Madison Ave., New York 17, N. Y.

Arthur P. Schulze is now manager of public relations and advertising of **Diamond Alkali Co.**, 300 Union Commerce Bldg., Cleveland 14, Ohio. Mr. Schulze was formerly affiliated with Hill and Knowlton.

Donald G. Marshall has been appointed electronics development engineer on the engineering staff of



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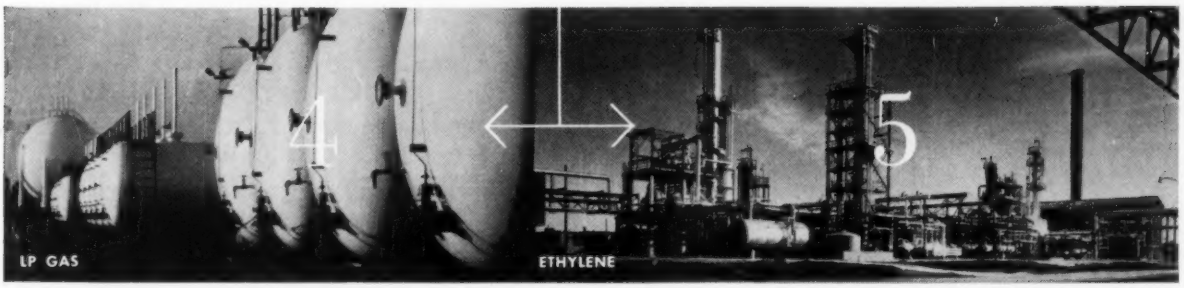
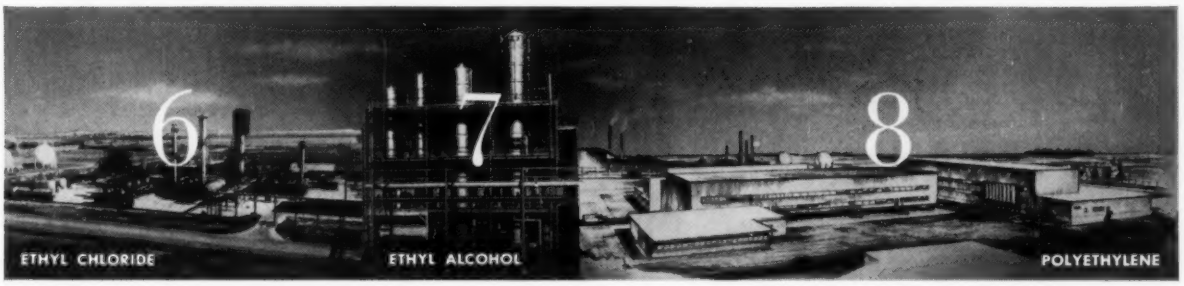


Polyethylene in 1955... INTEGRATION



In the Spring of 1955, National Petro-Chemicals Corporation will become a large-scale polyethylene supplier, marketing the trade marked product "Petrothene" on long-term contract basis.

Petro's highly integrated operations — processing natural gas to high purity ethylene and in 1955 to polyethylene — will be conducive to the maintenance of stable polymer synthesis conditions. Thus, customers will be assured of a steady supply of quality polyethylene for their specific requirements.

The flow diagram above shows the Petro plant in its entirety. Natural gas is extracted from Panhandle Eastern's pipeline and fractionated. Propane and butanes feed the LPG market. Ethane is cracked to ethylene which in turn is converted to ethyl chloride or ethyl alcohol, or in 1955 to polyethylene.

As your markets expand, Petro will be in there with increased quantities of quality polymer to meet your needs. Consult with us now on your future requirements of "the world's first billion-pound plastic."

"PETROTHENE"— THE POLYETHYLENE FOR TOMORROW

NATIONAL PETRO-CHEMICALS

C O R P O R A T I O N

A joint enterprise of National Distillers Products Corporation and Panhandle Eastern Pipeline Company

99 PARK AVENUE, NEW YORK 16, N. Y.

THE PLASTISCOPE

Exact Weight Scale Co., Columbus, Ohio. Much of Mr. Marshall's work will be concerned with development of special electronic scales for the plastics and plastics molding industries.

Jack T. D. Cornwell has been appointed advertising and sales promotion manager of Celanese Corp. of America's Chemical Div., 180 Madison Ave., New York 16, N. Y. Mr. Cornwell previously had been with Hazard Advertising Co. since 1946 as account executive supervising advertising and sales promotion activities for leading producers of industrial and organic chemicals.

Walter E. Coleman has been named sales manager of the Dry Color Dept. of **Zinsser & Co., Inc.**, Hastings-on-Hudson 6, N. Y. Mr. Coleman was formerly connected with Reichhold Chemicals, Inc.

David A. Foxman has joined **Abbey Record Mfg. Co.**, 1 Central Ave., East Newark, N. J., as executive vice president. Mr. Foxman was formerly production head of the Eastern Div. of Allied Record Manufacturing Co., Inc. He is a well-known authority in the plastics record industry and has been a consultant in the establishment of several of the better known plants in the country.

Freeman B. Hudson, Jr., has joined **American Cyanamid Co.'s Resins Div.** as purchasing agent. He was formerly associated with U. S. Rubber Co. for 10 years as a senior buyer of chemicals for raw materials.

Anthony C. Kupris is now general advertising manager of **R. M. Hollingshead Corp.**, Camden, N. J. He replaces R. E. Conley, who has resigned.

Burchard M. Day has joined **The Carborundum Co.**, Niagara Falls, N. Y., as advertising manager. His previous affiliation was with McGraw-Hill Publishing Co.

Richard T. Clark has been named director of sales for raw materials of **Monsanto Chemical Co.'s Plastics Div.**, Springfield, Mass. Mr. Clark was formerly district manager of Monsanto's Inorganic Chemicals Div. in San Francisco, Calif.

Archie F. Wilson is now director of manufacturing of **The Hydraulic Press Mfg. Co.**, Mount Gilead, Ohio. He was previously associated with Mather Stock Car Co., Chicago, Ill., as manager of plant operations, where he supervised operations of the company's eight plants throughout the country.

Melvin Helitzer, former director of public relations of Toy Guidance Council, Inc., has been appointed to the new post of director of public relations of **Ideal Toy Corp.**, 200 Fifth Ave., New York 10, N. Y.

Lee H. Pelzman has been named director of design of **Commonwealth Plastics Corp.**, Leominster, Mass. Mr. Pelzman will continue in his capacity as chairman of the board of American Tool & Finding Co., Inc., Providence, R. I.

W. C. Schade, formerly of Olin Industries, Inc., New Haven, Conn., has been appointed executive vice president and general manager of **Ball Brothers Co., Inc.**, Muncie, Ind.

Allen W. Schmidt is now advertising and sales promotion manager of **Resin Industries**, Santa Barbara, Calif.

Fred W. Troester has joined the sales staff of **The M. W. Kellogg Co.** in Los Angeles, Calif. He will handle sales of Kellogg's fluorocarbon materials in the Pacific Coast area. Mr. Troester was formerly East Coast representative of Rezolin, Inc., Los Angeles, handling phenolic casting resins used in aircraft and automotive tooling.

Correction

LAST month this column reported that C. F. Galehouse had joined Mastercraft Research Laboratories as a representative to handle their Tamco vacuum forming machines. That company's correct address is 619 W. 45th St., New York 19, N. Y. The address given in error was that of Mastercraft Plastics Co., Inc., now located at 95-01 — 150th St., Jamaica, N. Y. The latter company, molders and vacuum formers, recently moved across the street from its old address at 95-32 — 150th St.

Deceased

Alfred A. Morse, advertising manager of **Peerless Roll Leaf Co., Inc.**, Union City, N. J. Mr. Morse, who was widely known in the packaging, plastics, and graphic arts field, had completed 25 years of service with Peerless this year.

MEETINGS

Sept. 12 — Commercial Chemical Development Assn., Dinner Meeting, Hotel Statler, New York, N. Y.

Sept. 12-16 — American Institute of Chemical Engineers, Meeting, Hotel Colorado, Glenwood Springs, Colo.

Sept. 12-17 — American Chemical Society, 126th National Meeting, Hotel Statler, New York, N. Y.

Sept. 21-23 — Society for Experimental Stress Analysis, Annual Meeting and Exhibition in Conjunction With First International Instrument Congress and Exposition, Bellevue-Stratford Hotel, Philadelphia, Pa.

Sept. 23-26 — Packaging Machinery Manufacturers Institute, Twenty-second Annual Meeting, Grove Park Inn, Asheville, N. C.

Oct. 7-8 — Commercial Chemical Development Assn., Annual Fall Meeting, Bedford Springs Hotel, Bedford, Pa.

Oct. 7-9 — International Plastics Congress, Oslo, Norway. Those desiring to attend should address the Secretariat: Forening for Norsk Plastindustri, Munkedamsveien 53 B. Oslo.

Oct. 12-15 — Chicago Section of the American Chemical Society, Eighth National Chemical Exposition, Chicago Coliseum, Chicago, Ill.

Oct. 26 — Association of Consulting Chemists and Chemical Engineers, Inc., Annual Symposium and Banquet, Hotel Belmont Plaza, New York, N. Y.

Nov. 9-11 — Packaging Association of Canada, Third Canadian National Packaging Exposition, CNE Automotive Bldg., Toronto, Ontario, Canada.

CLASSIFIED ADVERTISEMENTS

MODERN PLASTICS reserves the right to accept, reject or censor classified copy.

EMPLOYMENT • BUSINESS OPPORTUNITIES • EQUIPMENT (used or resale only)

MACHINERY and EQUIPMENT FOR SALE

HYDRAULIC PRESSES: 1—Erie Belt Press, 4242 Tons, 2—8" openings, 18'-0"x52" Steel Steam Platens, 6 rams—30" dia. x 16" stroke. 1—Birdsboro, 2000 Tons, down-acting ram 34" dia. x 14" stroke, 48" DLO, 42"x42" bed area. 1—HPM, 750 Tons, down-acting, ram 28" dia. x 43" stroke, 72" DLO, 59"x44" bed area, MD low and high pressure pumps and accumulator system. 1—Clearing, 500/1500 Tons, completely self-contained with controls for manual or automatic operation, suitable for compression and injection molding. 1—Baldwin-Southwark, 400 Tons, Slab-side, 30"x30" Steel Steam Platens, 23" DLO, ram 21"x17" stroke. 1—Farrel, 393 Tons, 48"x48" Steam Platens, 2—15" openings, 4 rams 10" dia. x 24" stroke, approx. 15" per opening. 1—Baldwin-Southwark, 200 Tons, 3-opening, 20"x20" Steel Steam Platens, ram 12" x 20" stroke, 3500 PSI. Southwark, 200 Tons, 2-opening, 30"x30" Steel Steam Platens, ram 14"x14" stroke. 1—Thropp, 150 Tons, 36"x36" Steel Steam Platens, 15" DLO ram 14"x12" stroke. 1 Watson-Stillman, 100 Tons, down-acting ram 11½x9½"x6" stroke, 22"x20" bed, 24" DLO, self-contained, 15 HP MD Vickers pump. Unit practically new. 1—Watson-Stillman, 100 Tons, 11¾"x12" Platens, 22½" DLO, ram—8" dia. x 15" stroke, complete with 3 HP MD Pump. 1—HPM, 100 Tons, 18"x18" Platen Area, ram—8" dia. x 18" stroke, 30" DLO, steel cylinder—4000 PSI. 2—Burroughs, 75 Tons, down-acting, 17½"x17" Electric-Heated Platens, 13½" DLO, ram—8" dia. x 10" stroke, complete with 7½ HP MD Oilgear Pump. 1—HPM, 35 Tons, down-acting ram 6" dia. x 6" stroke, 15" DLO, 12"x6" bed area, self-contained. 1—Northern, 20 Tons, model 20-G, 18"x12" bed, 8" throat, 12" DLO, 12" stroke, 5 HP MD Pump, controls. 1—Indusco Laboratory Press, 12 Tons, hand operated, 8"x8" Electrically Heated Platens. New. INJECTION MOLDING MACHINES: 1—Plasticor Vertical 2 oz., Electric Heated, Hand Operated. 1—HPM Horizontal Model 54, 2 oz., 22 Ton Clamp, 12 Ton Injection, Manual Control, Oil Heated. 2—HPM Model 200-H, 9 oz., 200 Ton Clamp, 31 Ton Injection, Electrically Heated, Full Controls, Excellent Condition, in operation. 2—Impco Model VF-822A, 22 oz., 350 Ton Clamp, 100 Ton Injection, Electrically Heated, Full Controls, Excellent Condition. In operation. Also: Plastics and Rubber Extruders, Mills, Mixers, Grinders, Injection Molding Machines, Pumps, Valves, Platens, etc. JOHNSON MACHINERY COMPANY, 683-M Frelinghuysen Ave., Newark 5, New Jersey. Tel.: BIgelow 8-2500. What have you for sale? What are you looking for?

FOR SALE: Leominster 8 oz. Injection Molding Machine complete late type. Plastic and Rubber Equipment. Farrel 16"x48", 15"x36" and 6"x12", 2 roll mills. Mills and Calenders up to 84". New Seco 6"x12" and 6"x16" Lab. Mixing Mills and Calenders. Rubber & Plastic Extruders. Stokes #280, 4" dia. Preform Machine. HPM 200 ton 30" x 48" Platens. 350 ton 22"x24". New Loomis 340 ton, 24"x56" platens. Southwark 350 ton, 42"x24" platens. 200 ton Brunswick 21"x21" Platens, 14" Ram Record Presses. 100 ton 24"x24". Elmes 75 ton 30"x36". Also presses Lab. to 2000 tons from 12"x12" to 48"x48". Hydr. Oil Pumps. Gould 75 HP motor Dr. 2 stage Centrif. Pump 250# W.P. W.S. 4 Plgr. High and Low Pressure Hydr. Pump. Elmes Hor. 4 Plgr. 4500 lbs. and 5500 lbs. Hydr. Accumulators. Stokes Automatic Molding Presses. Rotary & Single Punch Preform Tablet Machine ½" to 4". Injection Molding Machines 1 oz. to 32 oz. Baker Perkins Jacketed Mixers 100, 50, and 9 gal. Plastic Grinders. Heavy duty mixers, grinders pulverizers, gas boilers, etc. Partial listing. We buy your surplus machinery. STEIN EQUIPMENT CO., 107-8th Street, Brooklyn 15, N.Y. STerling 8-1944.

FOR SALE: Plastic Moulding Machines, very reasonably priced: 2 used 8 oz. injection moulding machines in good working condition. May be seen in operation. VAN BRODE MILLING CO., INC., Clinton, Mass. Phone: Clinton 2190.

(5) NEW WATSON-STILLMAN EJECTION Molding Heating Chambers, one four ounce, one six ounce, two eight ounce, one sixteen ounce. Price one third the cost of new. New 75 ton presses, size 22x22, 10" ram, 10" stroke, $1100 each, ten day delivery f.o.b. Brooklyn, New York, one or more can be obtained. HYDRAULIC SAL-PRESS CO., INC., 388 Warren Street, Bklyn., N.Y.

AVAILABLE AT BARGAIN PRICES

Colton 2RP and 3RP 10-35 Rotary & #5½ Tablet Machines. Rotex, Tyler Tum-mer, Selectro, Robinson, Raymond, Gayco, Great Western Sifters. Mikro Bantam, 1SH, 2TH, 3W, 4TH Pulverizers; Schutz O'Neill Mills. Baker Perkins Heavy Duty Steam Jacketed, Double Arm, from 12 to 200 gal., Mixers (Unidor and Vacuum also). J. H. Day, from ¾ up to 100 gal., Imperial and Cincinnatus D. A. Jacketed, Sigma Blade Mixers. Day, Robinson, Munson Dry Powder Mixers, 15 to 10,000 lbs., all sizes. F. J. Stokes RBB Rotary and R Tablet Machines. Package Machy. FA, FA4, Miller, Hayssen, Scandia, Oliver Auto. Wrappers. REBUILT AND GUARANTEED—This is only a partial list. Over 5000 machines in stock—available for immediate delivery. Tell us your machinery requirements. UNION STANDARD EQUIPMENT CO. 318-322 Lafayette St., New York 12, N. Y.

SAVE WITH GUARANTEED REBUILT EQUIPMENT: Hydraulic Presses: 2 new R.D. Wood 500 ton 54"x26" platen, 42"x37", 20" ram, 475 tons; 2-7 opening 27"x27", 18" ram, 565 tons; 24"x24" 12" ram, 170 tons; 24"x20" 10" ram, 118 tons; 20"x20" 10" ram, 118 tons; 20"x20" 10" ram, 200 tons; 30"x20" 8" ram, 75 tons; 24"x20" 8" ram, 75 tons; 14"x14" 8" ram, 75 tons; 15"x15" 8" ram, 75 tons; 2-19"x24" 10" rams, 78 tons; 12"x12" 6½" ram, 50 tons; 14"x14" 8" ram, 50 tons; 8"x 9½" 4½" ram, 20 tons; 16"x16" 3½" rams, 12 tons; PREFORM PRESS: Colton 5½ T. Reeves Drive and Motor, late type Stokes Model T; LABORATORY PRESSES: Carver & Watson Stillman Units; NEW UNIVERSAL DUAL PUMPING UNITS: 3-15 HP; NEW LABORATORY MILLS, and CALENDERS; EXTRUDER; Modern Plastic late type 3½"; ACCUMULATOR: HPM 6" ram 2500#, also Mixers, Vulcanizers, Injection Molding Machines, etc. UNIVERSAL HYDRAULIC MACHINERY CO. INC., 285 Hudson Street, New York 13, N. Y.

FOR SALE: 1—F.B. 32"x92" inverted-L 4 Roll Calender, reduction drive, d.c. vari-speed motor; 1—Adamson 5'x28' Vulcanizer, quick-opening door, A.S.M.E.; 1—5'x12' quick-opening door, 125 psi. 1—Royle #4 Extruder, motor driven. 1—6"x12" Laboratory Mill, m.d. 1—Ball & Jewell #2 Rotary Cutter, 15 h.p. motor. 3—#28 Devine Vac. Shelf Dryers, 19—59"x78" shelves, complete. 1—Farrel-Birmingham 16"x13" 3 Roll Calender. 4—Hymac 150 ton 18"x18" Hydraulic presses, electrically heated platens, 9" dia. rams. 1—Farrel 20"x22"x60" mill, top cap frame, falk reduction drive, 100 h.p. motor. 2—Farrel 16"x42" Mills with reduction drive and 100 h.p. motor. Also other sizes: Hydraulic Presses, Tubers, Banbury Mixers, Mills, Vulcanizers, Calenders, Pellet Presses, Cutters. Send us your inquiries. What have you for sale? CONSOLIDATED PRODUCTS CO., INC., 50 Bloomfield Street, Hoboken, N. J. HOboken 3-4425. N. Y. Tel.: BArclay 7-0600.

FOR SALE: Automatic, coin operated, coffee dispensing machine. Serves coffee black, with sugar, cream or both. Ideal for building employee morale. Reduces time for "coffee break". In good operating condition. Reasonable. Reply Box 2147, Modern Plastics.

FOR SALE

Two 12-ounce and two 16-ounce Watson-Stillman Injection Molding Machines 5 years old. Have always received perfect maintenance and are in excellent operating condition.

STANLEY BERG & CO.

Frick Bldg. Pittsburgh, Pa.

FOR SALE: Injection Presses: 4, 8, 16 & 22 oz. Reeds, 4, 9, 16 oz. HPM, 15 oz. Crown Moldmaster, 3 oz. Moslo, 1 oz. VanDorn. Scrapgrinders, Ovens. Compression & Transfer presses: 50, 100, 250 tons. Stokes Standard Transfer 258. Preform presses. 42" Slitting & Rewind machine. 3 HP Gasboilers. McBeth Daylite Test-booth Equipment to be inspected in operation. List your surplus equipment with me. JUSTIN ZENNER, 823 Waveland Ave., Chicago 13, Ill.

FOR SALE: One factory reconditioned 8 oz. Reed-Prentice cylinder not used since reconditioning. Price $750.00. Reply Box 2120, Modern Plastics.

FOR SALE: Hobbing Press 800 Ton W.S. (2) 300 Ton W.S. Presses 20x20 & 29x24 Platens. 140 Ton W.S. 22x16 Platen. 85 Ton Waterbury Farrel 20x24 Platen. 63 Ton Press 15x15 Platen with Pullback Cyls. 9, 8, 4, Oz. Injection Molding Machines. 15 Ton Lab. Presses 10x8 Platen. 10 Ton Lab. Presses 6x6 Platen. Ball & Jewell Plastic Grinders. Standard Mystic Embossing Presses. Accumulators, Pumps, Valves. Many other Presses—Send For Bulletin. New Presses Built to Suit Your Requirements. AARON MACHINERY CO., INC., 45 Crosby St., New York 12, N. Y. Tel. WOrth 4-8233.

FOR SALE: Elmes Hydraulic Press, 30 ton capacity, 12" x 12" platen, 6" stroke, 10" daylite, air operated, gravity return, used, good condition. $550.00. Brookfield Viscometer, Model L.U.F., Serial No. 4049, with case and extra spindle, new condition. $175.00. Wood Welder, Model W. P., 15 amp., 3418 B.T.U., with Booster unit and welding head, used, good condition. $250.00. RIPPOLITE PLASTIC PRODUCTS, INC., 3910 Cohasset Street, Burbank, California.

FOR SALE

One complete set up for extrusion. One 2½" National Rubber machine with oil heater and drive; one conveyor 5" channel complete with drive and motor. This equipment in excellent shape. Can be seen in operation by contacting owners through Box 2122, Modern Plastics.

KUX MODEL 25 AND STOKES RD3 Rotary Presses; B & J Rotary Cutters #1½ and Standard Ideal; Mikro Pulverizers Bantam, #1-SH, #2-SI, #2-TH; B.P. 50 HP; 50 gal. Sigma Blade Jacketed Mixer; W & P 100 gal. Mixer and 1 qt. and 10 gal. Stainless Steel Mixers. Large stock steel and stainless steel tanks and kettles. PERRY EQUIPMENT CORP., 1429 N. 6th St., Philadelphia 22, Pa.

FOR SALE: 48 ounce Watson-Stillman, 1952. 48 ounce DeMattia, new. 22 ounce Impco vertical, $10,500. 20 ounce Lester, new 1950, $16,000. 16 ounce H.P.M., $11,000. 16 ounce Reed-Prentice, new 1950. 12 ounce Crown Moldmaster, $10,500. 12 ounce Lester w/16 oz. cylinder, 8 ounce Reed-Prentice, 1946, $8,500. 8 ounce Reed-Prentice, double link, $6,500. 8 ounce Lester, 1949, $8,000. 8 ounce Leominster, $5,000. 4 ounce Impco, $8,000. 4 ounce Lester, $3,500. 4 ounce Lester, Vertical. 4 ounce Acme, new. 2 ounce Watson-Stliiman, vertical, almost new. ACME MACHINERY MFG. CO., 102 Grove St., Worcester, Mass.

FOR SALE: 3 Colton 5½T preform presses, 3" max. diameter; 1—500 ton French oil mill hydraulic press, 36" x 48", 24" ram; 1—1200# stainless steel jacketed ribbon blender; 2 Ball & Jewell rotary cutters 1 HP and 5 HP; 1 Hartig 1¼" electric extruder. Also mixers, mills presses, etc. CHEMICAL & PROCESS MACHINERY CORP., 146 Grand St., New York 13, N. Y. Tel: WOrth 6-3430.

FOR SALE

One 8-ounce Reed-Prentice Injection Molding Machine 5 years old. Has always received perfect maintenance and is in excellent operating condition.

STANLEY BERG & CO.

Frick Bldg., Pittsburgh, Pa.

HYDRAULIC PRESSES rebuilt, repaired. Used presses from laboratory to 1000 tons standard and special, molding and hobbing presses, etc. Used pumping units up to 10,000 p.s.i. all capacities. CLIFTON HYDRAULIC PRESS CO., 291 Alwood Rd. P.O. Box 325, Clifton, New Jersey.

FOR SALE: Stainless Steel Rotary Dryer, Link Belt Co., 5'2"x16', No. 502-16, with all auxiliary equipment. Roto Louvre type. Reply Box 2149, Modern Plastics.

FOR SALE: Two 1953 Crown 12 oz. preplasticising presses $25,000 for the two. Reply Box 2118, Modern Plastics.

FOR SALE

One 4 ounce and one 8 ounce Reed Prentice Molding Machines.

F. J. KIRK MOLDING CO., INC.

Clinton, Mass. Tel.: Clinton 1871

(Continued on page 272)

(Continued from page 270)

MACHINERY and EQUIPMENT WANTED

WANTED: Plant or Machinery including Rubber Mills, Hydraulic presses, Sturdy mixers, Calenders, Banbury mixers, Pulverizers, Grinders, Rotary cutters, Extruders, Screens, Injection Molding machines, Dryers. CONSOLIDATED PRODUCTS CO. INC., 50 Bloomfield Street, Hoboken, N.J. HOboken 3-4425, N.Y. Tel.: BArclay 7-0600.

WANTED: No. 3 Banbury Mixer, Calender, Extruder, 4 oz. Injection Molding Machine. Advise where can inspect. Reply Box 2150, Modern Plastics.

MATERIALS FOR SALE

FOR SALE:
20,000 lbs. Virgin Copper Polystyrene; 25,000 lbs. Virgin Ivory high impact Polystyrene; Various Colors Reprocessed high impact Polystyrene Pellets; 20,000 lbs. Black Reprocessed Butyrate Pellets, also Red, Green, Blue, Flesh Pink Butyrate; 10,000 lbs. each Red, Blue, Green Reprocessed Polyethylene Pellets; various Bright Colors Reprocessed Acetate Pellets. Samples on request.
A. BAMBERGER CORPORATION,
703 Bedford Ave., Brooklyn 6, N. Y.
Telephone MAin 5-7450.

FOR SALE: RBH vinyl dispersions—232 lbs. VC cadmium red lt. C-5060; 734 lbs. VC cadmium red dp. C-5062; VC iron blue C-5045; 184 lbs. VC white lead carbonate C-5057; 412 lbs. lithol red med. C-5037; 3886 lbs. resin paste TiO_2 anatase P-30E142. Wilson Prod. vinyl dispersion—1112 lbs. VC chrome green oxide S-326. Materials offered below market. CHEMSOL, INC., 74 Dod Court, Elizabeth, N.J. EL. 3-1369.

MATERIALS WANTED

WANTED:
Plastics Scrap in rejects of all kinds, ground and unground. Also rejected molded pieces and surplus virgin molding powders. Top prices paid.
A. BAMBERGER CORPORATION,
703 Bedford Ave., Brooklyn 6, N. Y.
Telephone MAin 5-7450.

ATTENTION! REINFORCED PLASTICS MFRS. Record sales producer pioneering polyester laminates in the building field, wants a new product. Strong dealer and professional following North and South. Have practical ideas for needed items. Reply Box 2151, Modern Plastics.

WANTED: Plexiglas and Lucite scrap, salvage and cut-offs, any quantity. DUKE PLASTICS CORP., 406 Atlantic Ave., Bklyn. 17, N. Y. Ulster 8-9413.

MOLDS WANTED

WEST COAST INJECTION MOLDER interested in leasing houseware and toy molds for distribution in the eleven western states only. Obsolete and current items acceptable. Freight on molds paid both ways also leasing fee in advance if required. Will need molds for approximately six weeks only. Molds insured when leaving your plant until return.
Reply Box 2131, Modern Plastics.

MOLDS WANTED EXCLUSIVELY FOR EXPORT. Current inquiries: hinged-lid spectacle cases (Reed 10D-8); tableware, utensils, novelties (1-2-6-8-12-16 ozs.). Submit full details (including commission) on ALL idle, excess, GOOD-CONDITION molds for housewares, notions, toys, dolls, etc. Interested rental molds size 13¾x15¾", 3½-4¼ ozs. also for V-Dorn 1 oz. machines. CUMBERLAND STEEL CO., 25 Beaver Street, N.Y.

BRUSH MOLDS & BRUSH MACHINERY, injection molds for ladies, men's, military, nail, toothbrushes, etc. Send particulars & samples. Box 1000, REALSERVICE, 110 W. 34 St., N. Y. C.

MOLDS WANTED for Injection Molding. For Adult Game Items. Send samples and particulars. Need Chess, Checkers, Poker Racks, etc. Reply Box 2137, Modern Plastics.

PLANTS FOR SALE

FOR SALE
Complete wood flour mill. Capacity 10 tons per 24 hours, using nearby supply of pine and poplar. For further particulars, reply Box 2102, Modern Plastics.

PLASTIC PLANT For Immediate Sale—Less than 50% of Value! Modern, Established, Prosperous Mid-West Injection Molding Plant. Large Volume Operation—Complete Production Facilities—AAAI Accounts. Consumer Products and Custom Molding. Unlimited Possibilities For Several Engineers and Operating Men To Get Together To Purchase All Or Percentage of Interest—Retaining Present Staff. No Down Payment. Only $100,000 Cash For Working Capital—Balance Long Term Based On Percentage Of Sales. Mail inquiries only, to: KAMENY ASSOCIATES, ADVERTISING, 21 W. 45th St., New York 36, N.Y.

HELP WANTED

VINYL CHEMIST
Experienced on heavy or light gauge calendering. All replies handled in strictest confidence.
Reply Box 2132, Modern Plastics.

SALES ENGINEER—Injection Moldings or complete items that require Metal Stampings or Screw Machine Parts. Reply Box 2106, Modern Plastics.

PLASTIC SCRAP COMPANY is opening in New York-New Jersey area—buy scrap and sell compounds. Excellent opportunity to grow with expanding organization. Liberal salary plus commission. Reply Box 2146, Modern Plastics.

PRODUCTION MAN to set up small department for imbedding objects in clear plastic, preferably part time; North Jersey. Address P. O. BOX 997, New York 8, N. Y.

SALES ENGINEER to represent old-established injection molder. Press capacity 4 to 200 ounces. Tool room, painting, silk screening, hot stamping—all conveyorized. Straightline assembly. Automatic packaging equipment. Prefer experienced men and men with industrial contacts. Also men controlling one or more special deals. Large midwest plant. Give complete details. Personal interview to follow. Reply Box 2100, Modern Plastics.

VINYL COLOR MATCHER
Require man experienced in color matching and production color control in vinyl film and sheeting operation.
Reply Box 2107, Modern Plastics.

PLASTICS EXECUTIVES—$5,000 to $25,000. We have immediate openings with leading national concerns for competent men in all phases of the Plastics industry. Rapid, confidential, nationwide service. For application, send your name and address to: E. B. Shea, Plastics Industry Division, DRAKE ENGINEERING PERSONNEL, 7 West Madison Street, Chicago 2, Illinois.

DEVELOPMENT ENGINEER — Reinforced Plastics. Wanted by large midwestern company, man who has had production experience on both hand lay-up and matched metal die molding and who is capable of estimating costs and die design and who can follow job from development through to production. Please reply fully giving education and experience to Box 2133, Modern Plastics.

WANTED—Experienced man in Philadelphia Area specializing in plastic extrusion, stampings, or die castings to represent prominent and well established custom molder with capacity for large and intricate parts by injection, compression, and transfer molding. Please reply Box 2127, Modern Plastics.

EXCELLENT SUPERVISORY OPPORTUNITY in plastics development field for man with imagination and ability to carry assignments to completion. Applicant must be familiar with properties and methods of evaluation of thermoplastics. Knowledge of relationship between molecular structure and properties of plastics most desirable. Position involves devising new methods for evaluation of plastics and practical interpretation and correlation of experimental data. Good opportunity for advancement on merit basis. Initial salary commensurate with training and experience. Please forward resume of qualifications. Reply Box 2125, Modern Plastics.

POLYESTER FABRICATION ENGINEER: We are seeking a man to develop practical fabrication techniques and to solve fabrication problems for our customers using a new line of Polyester Resins. Knowledge of Hand Lay-Up, Bag Molding, and Matched Metal Die Techniques are particularly desirable. An excellent opportunity in a large progressive Chemical Company. Reply PO Box 344, Niagara Falls, New York.

EXTRUSION—Experienced extrusion engineer or dye design man for established custom extrusion house. Should be capable of handling special set-ups, various shapes, compounds, and independent action. Location metropolitan New York. Send full information in first letter. Reply Box 2109, Modern Plastics.

MECHANICAL ENGINEER—VINYL SHEETING. Medium size vinyl sheeting manufacturer desires services of engineer to form engineering group. Would prefer some one with experience in vinyl film or sheeting manufacture, although someone with allied experience will be considered. Good working conditions, considerate management, and challenging problems. Mail resume to: KAYE-TEX MFG. CORP., Yardville, N. J.

ENGINEER for reinforced plastic experimental and production work. Must have thorough knowledge of polyester-fiberglas laminating techniques. Bag and matched tooling experience particularly desirable. Excellent opportunity in an established firm in a southwestern state. Submit resume of experience and salary requirements. Reply Box 2103, Modern Plastics.

GENERAL FOREMAN—Supervise production in Northern Ohio Plastics Division of AAA-1 concern. Experience desirable in thermoplastic sheet forming and fabricating and molding of reinforced plastics. Will consider man with good supervisory background in injection and compression molding. Must be capable of assuming complete responsibility for cost control, quality and personnel. Reply Box 2140, Modern Plastics.

POLYESTER RESINS: Attractive salary with Profit Participation for individual or team thoroughly experienced in both Production and Sales. Reply Box 2135, Modern Plastics.

CHEMIST OR
CHEMICAL ENGINEER
with Polyethelene Extrusion Experience. Plant Eastern Seaboard desires man with complete knowledge and technical know-how of all phases of production and plant operation. Permanent position with excellent opportunity and salary. Send complete details and resume.
Reply Box 2123, Modern Plastics

PLASTIC PRODUCT AND TOOL DESIGN ENGINEER wanted by a young growing Pennsylvania concern in custom and proprietary molding of industrial parts. Experience in compression and transfer molding desirable. Please state experience, age, and family status, plus salary desired. Reply Box 2111, Modern Plastics.

PROJECT ENGINEER for nationally known manufacturer in Northern Ohio to design and develop plastics extruders and accessories. Must have ME degree and substantial experience in heavy machinery design, preferably plastics processing equipment. Salary open. Reply Box 2117, Modern Plastics, submitting full resume.

INJECTION MOLDING FOREMAN. Large molding company requires experienced man for growing department. Should be experienced in the molding of large sections from Polystyrene, and plastic steering wheels from Tenite II material. Must be able to make adjustments of machine cycles, work out molding problems, train operators, and maintain production schedules. Give full details such as experience, education, and salary expected in first letter. Replies will be held in confidence. Reply Box 2130, Modern Plastics.

PLASTIC CHIEF ENGINEER. Midwest injection molding plant doing Three Million Dollars requires experienced man responsible for estimating mold costs and mold design, production fixtures, customer product development and supervise all engineering functions. Salary commensurate with ability and experience. Unusual opportunity, work with management group.Confidential. Reply Box 2101, Modern Plastics.

TECHNICIAN CHEMICAL SPECIALIST Management Ebonite and Rubber covering of rollers for Cloth Dyeing and Paper Machines wanted for North Italy. Submit detailed experience. Write to: SPERLING & KUPFER—Piazza San Babila 1, Milano / Italy.

(Continued on page 274)

(Continued from page 272)

PLASTICS PLANT SUPT. Nationally known plastic concern with 20 injection and extrusion machines is seeking topnotch plant superintendent with thoro knowledge of molding techniques, engineering, tool design, finishing, production control and can administer and direct department heads and 250 employees. Excellent future. Sound organization. Mr. Harry Scheer, pres., SUPERIOR PLASTICS INC., 426 N. Oakley Blvd., Chicago 12, Ill.

CHEMIST OR CHEMICAL ENGINEER
Experienced in manufacture of vinyl floor tile. Excellent opportunity for personal advancement.
Reply Box 2108, Modern Plastics.

PLASTIC ENGINEER. Large molding company requires an experienced man for expanding injection molding department. Should be thoroughly experienced in molding and finishing plastic steering wheels. Must be capable of training personnel, supervising the setting up of any molds, set molding standards, and work out new finishing techniques. Excellent future for qualified person. Your inquiry will receive immediate attention and will be held strictly confidential. Send full details, work history, and salary required to Box 2129, Modern Plastics.

OUTSTANDING SUPERVISORY OPPORTUNITY for man with sound background in development of thermoplastic products. Must possess imagination, ingenuity and ability to aggressively carry projects to completion. Also must be capable of independently planning, evaluating and supervising activities of large group engaged in product development and improvement, experimental processing and properties evaluations of thermoplastic materials. Must have sound knowledge of plastics processing and testing technology. Definite opportunities for advancement on basis of demonstrated ability. Initial salary commensurate with background. Middle Atlantic States Area. Please send resume of training and experience. Address: Box 2116, Modern Plastics.

WANTED: YOUNG MAN for chemical engineering work with two or more years in Organic Chemistry in University or technical school. Need not be graduate engineer. Reply Box 2115, Modern Plastics.

PLASTICS ENGINEER—Product Design, Tool Development and Process Engineering for parts in formed thermo-plastics and molded reinforced materials. Must have ability to couple good design with practical tooling and production methods. AAA-1 concern in Northern Ohio will consider only those with good engineering background in the plastic materials mentioned above. Reply Box 2138, Modern Plastics.

SITUATIONS WANTED

REINFORCED PLASTICS ENGINEERING EXECUTIVE—Thoroughly familiar with all techniques and phases of manufacturing small and very large objects. Excellent stress analyst and machine designer. Experienced in cost estimates, control, and administrative supervision. Energetic, inventive, with proven record of accomplishments. Presently employed with nationally known manufacturing company. Seeks top level executive position or opportunity to create or expand reinforced plastics business. Principals only. Reply Box 2141, Modern Plastics.

VACUUM FORMING—Practical cost conscious engineering executive. Thoroughly familiar all phases; production, estimating, development and sales from .0075 packages to .125 industrial components. Capable of setting up complete integrated operation including mold making, fabricating, printing, die-cutting, assembly, etc. Can train personnel and develop new techniques and equipment. Well recommended, recognized expert in field. Highly intelligent, personable, adaptable. Will relocate. Reply Box 2145, Modern Plastics.

SALES MANAGER OR REPRESENTATIVE, age 30, Harvard College Graduate, Economics-Chemistry, Columbia University M.A., 5 years sales promotion and advertising experience (3 years as Assistant Sales Manager and Advertising Manager of nationally known organization) 3 years government service, wishes connection with plastic pipe manufacturer offering good future. Excellent references. Reply Box 2143, Modern Plastics.

ENGINEERING CONSULTANT. Have worked with every type of slush molding, rotational casting, and sectional molding set up. Guaranteed to make each organization self sustaining. Experienced in industrial and novelty field, waxes, pattern making, master molds, compounding and formulating, etc. Pioneer in plastisol field. Reply Box 2110, Modern Plastics.

ADMINISTRATIVE EXECUTIVE: two engineering degrees; sixteen years in compression, injection and extrusion. Successful experience record includes executive administrative management, plant management, sales management, toolshop management, personnel management, research and development, product development, product and mold design, estimating systems, scheduling systems, warehousing systems, cost analysis and company reorganizations. Interested in investing and participating in existing molding company. Reply Box 2148, Modern Plastics.

ATTENTION MOLDING POWDER MANUFACTURERS. Cost conscious Chem Eng (BChE) with a Master's degree in Business Administration (MBA) seeks position with a future in production or administration. Experienced in coloring, compounding of thermoplastics on extruders and banbury, color—matching, scrap reclaiming, production supervision, production control, and purchasing. Married, age 31. Will relocate. Reply Box 2134, Modern Plastics.

SALES REPRESENTATIVE, 10 years successful experience in custom molding and fabrication, wishes to represent producer of high quality molded or fabricated parts for electrical and electronic users. Any specialty considered but must be established quality producer. New England area. Commission. Reply Box 2139, Modern Plastics.

SALES AGENTS WANTED

WANTED: One of the major and most aggressive custom injection molding companies located in the midwest requires the services of well established, highly aggressive manufacturers' agents. Company will establish one each for New York, Pennsylvania, Ohio, Indiana and Minnesota areas. Company has a very fine reputation throughout the industry and has pioneered for the last eight years in the custom molding of nylon as well as all other thermoplastics. Give all qualifications in first letter.
Reply Box 2126, Modern Plastics

MANUFACTURER'S SALES REPRESENTATIVES wanted for Michigan, Illinois, Indiana, Ohio, New York, New Jersey, Pennsylvania, Maryland and Virginia by well known and established California companies doing low and medium pressure plastic laminating and metal bonding; making sandwich structures; producing aluminum and glass fabric core materials; manufacturing resin impregnated and coated fabrics, high strength adhesives and low pressure resins and conducting diversified plastics and adhesive research and development. We are interested only in men of proven ability who are now calling on industrial accounts. Commission basis. Reply giving territory you now cover, present lines and how long represented, references, names of personnel employed and brief background. Reply Box 2113, Modern Plastics.

PLASTIC
SALES REPRESENTATIVES
To take on an additional line for Chicago (mid-western states) or New England area. To contact users of ACETATE STYRENE. Sheets, Rolls, Film, Rods, and Tubes in all gauges and colors.
We are long established in the plastic field. Can offer a good proposition to a man that has the ability to produce results.
Send us a resume about yourself and territory you can best cover.
Address P.O. BOX 27, ARLINGTON, N.J.

SALES REPRESENTATIVES wanted for all territories by very large custom injection molders. Fully equipped plant. Large size presses. Located in New York area. Commission basis. Reply Box 2121, Modern Plastics.

SALES REPRESENTATIVES wanted by Midwest injection molder equipped to produce high quality parts at competitive prices. Operations include molding of all thermoplastic materials, Metalizing, Painting, hot-stamping, assembly, etc. Can also furnish die-casting with plastics assemblies. Outstanding tooling facilities. Utmost cooperation assured. Liberal commission arrangement. Reply in confidence stating experience, territory desired and present lines. Reply Box 2136, Modern Plastics.

HYDRAULIC PRESS MANUFACTURER with product which has enjoyed a top reputation for 15 years seeks representatives in midwest and southwest with experience & contacts in Plastics, Rubber and Chemical industries. Reply Box 2128, Modern Plastics.

SALES REPRESENTATIVE: Progressive firm with complete forming and fabricating facilities for Thermoplastic sheets and molding Fibreglas, offers New England, Pennsylvania, Maryland and Washington D. C. territories. Manufacturers Representative with plastic sales experience desired. Sales contracts will be issued. Write to: DURABLE FORMED PRODUCTS, INC., 6 Greene St., New York 13, N.Y.

CUSTOM MOLDING REPRESENTATIVE: Rapidly expanding Chicago area custom injection molder requires representation in: Southern Illinois, Indiana, Ohio, Missouri, Iowa, Minnesota and Wisconsin. Excellent plant cooperation assured. Experienced in supplying all types of completely finished parts. Commission basis. All replies confidential. Reply Box 2104, Modern Plastics.

CUSTOM MOLDING REPRESENTATIVE: Midwest custom molding company requires representation in Chicago and other midwest areas on commission basis. Reply Box 2105, Modern Plastics.

REPRESENTATIVE WANTED: Small New England custom injection molding plant requires sales representative. We feel this is an opportunity to grow with an expanding company. Reply Box 2124, Modern Plastics.

MISCELLANEOUS

CUSTOM MOLDERS WANTED! Injection-Compression-Extrusion—who have products they desire to sell to the consumer, and need efficient distribution. We are a Natural Sales Organization selling to Wholesalers, Chains, Dept. Stores, Mail Order Houses, etc., who will completely manage your sales of consumer products on a straight commission basis. Complete promotion, merchandising, correspondence and all sales problems handled by us. Reply Box 2142, Modern Plastics.

PULP AND PAPER MILL located in Warrensburg, N. Y. interested in securing permanent year around connections for Yankee Fourdrinier M. G. Grades, toweling, saturating papers, ground wood and sulphite specialties. Address all correspondence and inquiries to THOMAS A. GALANTE & SONS, INC., P.O. Box 150, Mechanicville, N. Y.

ARE YOU SELLING IN THE CHICAGO AREA? If not contact us for experienced, established representation with excellent contacts in food processing, packaging fields, plus good jobber connections. We have personnel who will give you volume producing accounts that will be handled with aggressive interest for you. We are salesmen, not order takers. Try us for best results. Reply Box 2112, Modern Plastics.

AMERICAN REPRESENTATION for Foreign Plastic Manufacturers, now available. Nationwide distribution, covering a full range of plastic products, including molded, extruded, reinforced, and cast products. Interested in sound organizations assuring us of consistent quality, firm prices and delivery. Reply Box 2144, Modern Plastics.

AGGRESSIVE, cost minded, injection and compression manufacturing specialist with twenty-five years experience in plant set up and operation, desires to form partnership with company presently buying plastic parts, who would like to reduce cost and assure delivery by having their own source. Would consider individuals with proper connections with parts users. Have chemical engineering degree, capital. Reply Box 2114, Modern Plastics.

WANTED: BOXES—BOXES—BOXES. Packaging Material Supply House has outlet for substantial quantities of rigid transparent containers of any size and shape. Submit samples and prices and full packing specs to—BRANDYWINE INDUSTRIES, P.O. Box 854, Wilmington 99, Delaware.

ULTRA-MODERN MASONRY and steel building available for lease or sale approximately 13,000 sq. ft. One floor plan, perfect for injection molding, excellent midwest location. Ample labor supply. Reply Box 2119, Modern Plastics.

INTERESTED IN PURCHASING—Impco Hydraulic Press, Molds for Clothes Hanger, Dimethyl Phthalate, Diethyl Phthalate, Santicizer 8. PEERLESS CHEMICAL CORP., 181 Greene Street, N. Y. C. 12.

What This Machine Does:

It packages films and coated fabrics in roll form, with even edges and no wrinkles, at any tension from near-zero to high tension, at speeds up to 200 yards per minute.

It permits examination at any convenient speed and at the same time rolls up the goods perfectly with edges controlled by an automatic alignment device. When not examining, the operator can instantly switch to packaging speed.

It measures accurately in yards and eighths to give total yardage on roll.

It is highly versatile, permitting speed changes and tension changes with just a touch of a finger while the machine is in operation.

It is built by Van Vlaanderen, who has provided superior roll packaging and examining machines and other processing equipment for modern fabrics for over fifty years.

Van Vlaanderen Know-How

Why not call on Van Vlaanderen know-how in the design and manufacture of equipment for processing modern fabrics. Many of our standard machines can do a job for you on films and fabrics.

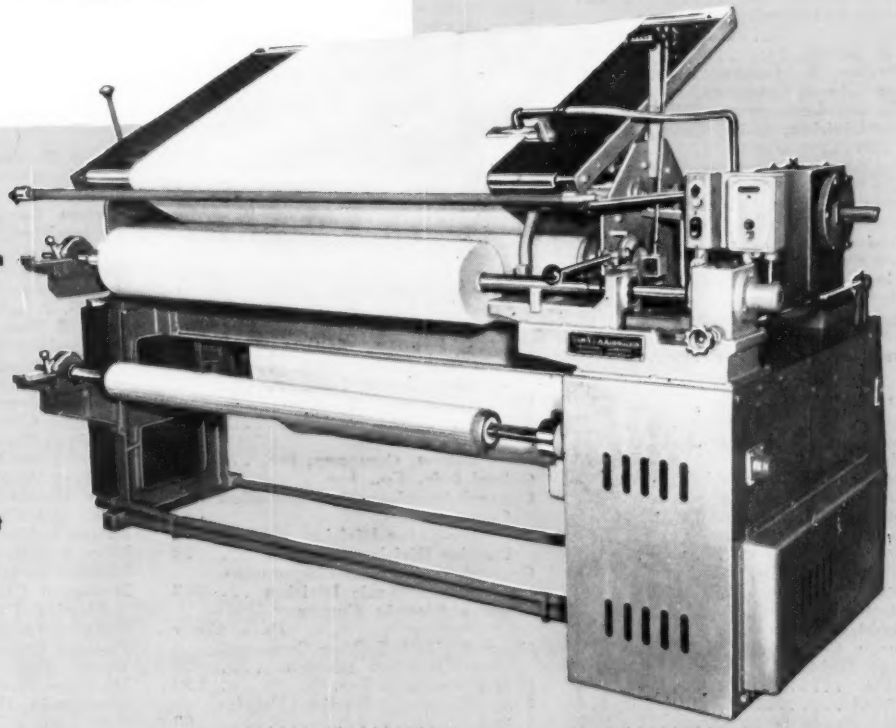
FOR INSTANCE:

THE VAN VLAADEREN COMBINATION INSPECTING AND ROLL PACKAGING MACHINE

Any material that is handled in rolls can be advantageously processed on this machine. Coated fabrics and films are inspected and roll packaged, with or without interleaving, in ONE OPERATION—or accurate, even edged, wrinkle-free rolling-up is done at speeds up to 200 yards per minute.

It is this combination of features that enables the Van Vlaanderen Combination Inspecting and Roll Packaging Machine to often replace two conventional machines—reducing materials handling costs.

Van Vlaanderen Engineers are ready to show you how this and other V.V. machines are adaptable to your needs. Contact us.



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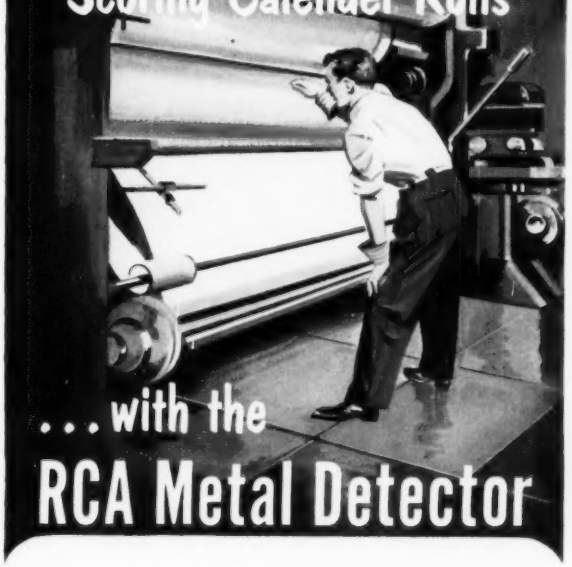
Prevent Tramp Metal from Scoring Calender Rolls

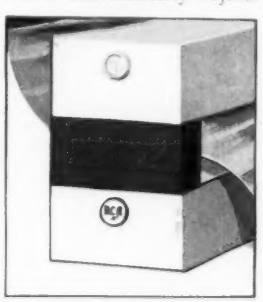


...with the RCA Metal Detector

If tramp metal is causing costly rejects and damaging expensive calendering and coating machinery, why not get the *positive* protection of the RCA Electronic Metal Detector?

Installed on your line, prior to calendering, the RCA Metal Detector will "see" dangerous imbedded metal particles. The detector can be set so that it permits metal in the pigment to pass, while detecting large tramp metal which might damage the equipment and delay production. It detects both magnetic and non-magnetic metals—even nickel, lead, brass and stainless steel.

When metal is detected, the RCA Metal Detector sounds an alarm and or stops the conveyor. If desired, it actuates a solenoid valve which automatically rejects defective rolls.



Add up all the savings . . . you'll find that the RCA Metal Detector in your plant could pay for itself many times over in the course of a year. For installation and service you can depend on the RCA Service Company whatever your address. Use coupon for complete details.

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This is DIAMOND PVC-50 *after blending with plasticizers, stabilizer and lubricant. Notice the free-flowing character of the dry blend and the absence of caking and agglomerates.*

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These qualities of DIAMOND resin not only result in easier processability and a more uniform product, but in many cases eliminate the need for high-cost mixing equipment. Products made from DIAMOND PVC-50 have excellent heat stability and other valuable characteristics.

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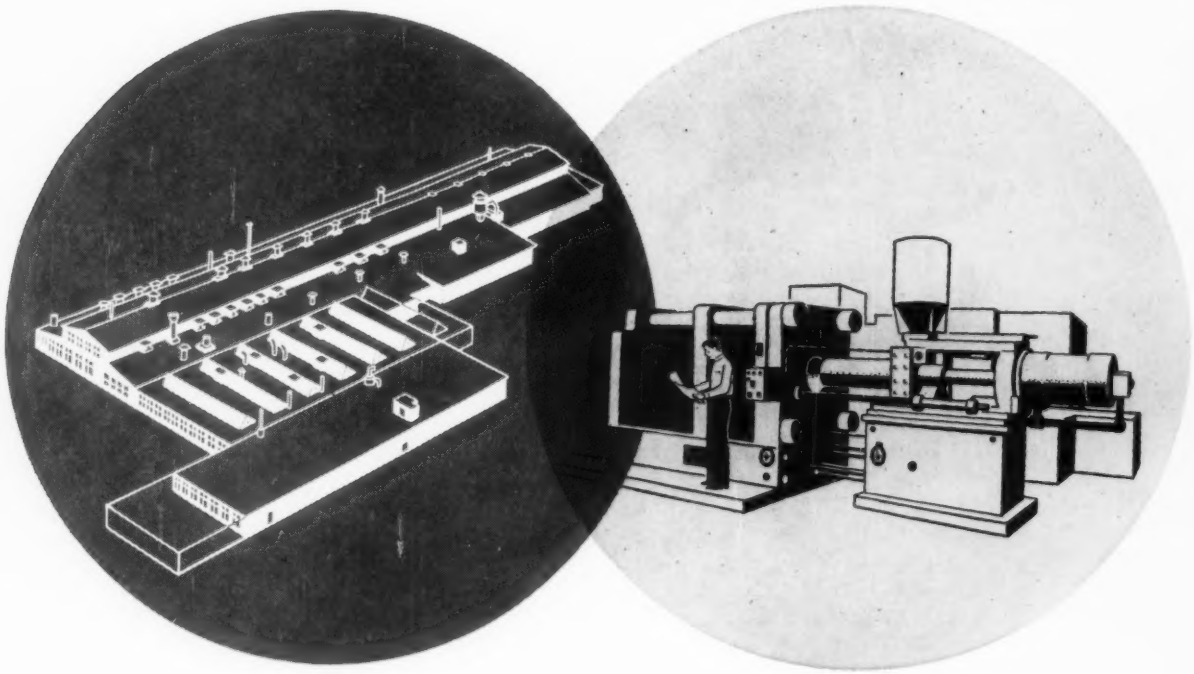

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